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The Society as a body is not to be considered responsible for any facts or opinions advanced in the several papers, which must rest entirely on the credit of their respective authors.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

12*th November* 1863.—Professor MACLAGAN, President, in the Chair.

H.R.H. Prince Alfred was elected by acclamation an Honorary Fellow of the Society.

The following Donations to the Society's Library were laid on the table:—

Proceedings of the Royal Horticultural Society, Vol. III., No. 7.—From the Society.

Proceedings of the Tyneside Naturalists' Field Club, Vol. VI., Part 1.—From the Club.

Synopsis of the Geology of Durham, by R. Howse and J. W. Kirkby.—From the same.

Proceedings of the Dublin Natural History Society, Vol. III., Parts I., II.—From the Society.

Proceedings of the American Academy of Arts and Sciences, October 1862.—From the Academy.

Mittheilungen der Naturforschenden Gesellschaft in Bern, 1862.—From the Society.

Schriften der Koniglichen Physikalisch-Okonomischen Gesellschaft zu Konigsberg, 1862.—From the Society.

Liste des Plantes de Belgique, offered in exchange by Armand Thielens, D.S.N.—From the Author.

The following Donations to the Herbarium were announced:—

From P. N. Fraser, Esq.—Plants collected in Western Australia by Captain Patullo.

From Dr John Lowe—Specimens of *Statice caspia*, collected near Hunstanston.

From Dr Milligan—Large Collection of Australian Plants.

From Dr Dickson—Specimens of *Scleranthus annuus*, var.

From N. B. Ward, Esq.—Specimens of *Fucus distichus*.

From W. H. Lightbody, Esq.—Specimens of *Peltidea aphthosa*.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Her Gracious Majesty the Queen—Relic of Herne's Oak from Windsor Park.

From Mrs Ross, Murrayfield—Skeleton Leaves, Flowers, and Fruits, with Glass Shade.

From Miss Newton—Skeleton Leaves of Indian Plants.

From S. C. Mackenzie, Esq.—Wax Models of Indian Fruits, and Skeleton Leaves of Indian Plants.

From James Mitchell, Esq.—Photograph of *Abies balsamea* growing at Wester Campsie, near Methven.

From J. Hogg, Esq.—Proliferous Cones of Larch.

From Mr Rabagliati—Suwarrow Nuts.

From Mr Yates—Fruit of *Passiflora cœrulea*, ripened at Lauderdale House.

From Dr Greville—Branch of Fern-Leaved Beech showing variation in Foliage.

From Mr Stephens—Wood affected with Dry-Rot.

From Mr Hewan, Surgeon, Calabar—Ordeal Beans.

From R. M. Stark, Esq.—Large Fruiting Spadix of *Gunnera scabra*, ripened in Lanarkshire.

From Dr Dyce Duckworth—Specimen of Plant from the Desert near Suez; Shepherds' Pipes from Hebron; Section of Olive Tree from Mount of Olives; vegetable Balls found on the sea-shore at Alexandria and Malta—they are composed of fragments of shore plants rolled together by the action of the waters; also vegetable powder called Hemeh or Henna, used by women in the East for dyeing their finger nails.

The President delivered the following Opening Address:—

It is my privilege and duty to address you on the opening of the Twenty-eighth Session of the Society. It appears to be a wholesome proceeding, warranted by the almost universal practice of scientific bodies, from time to time to take stock of their proceedings, to see whether they have been doing better or worse than might have been expected, and thus to be led in the future to endeavour to maintain or amend their position according to the indications which

the facts furnish. It is now when I am called to address you from this place that I feel more than ever the regret, which I expressed on first taking your Chair, that the hard requirements of medical practice and professional duty keep me so much a stranger to those pleasant fields of science, in which, both metaphorically and literally, it is the privilege of the botanist to roam. I feel that it is impossible for me personally to add anything to the Society's proceedings, and that, so far as your President is concerned, botanical work is virtually in abeyance. But this does not prevent me from looking with much interest, not perhaps unmixed with envy, at the work that is doing by others who have time, and talent, and industry for it. It may thus be possible for me, without greatly wearying you, to occupy a few minutes in reviewing the past Session of the Society, during which I have had the honour of being its President; and I think I may say that, looking at our printed Transactions, we can fairly maintain that we have not failed to do something for the promotion of botanical science. It is neither my duty nor my desire to make any approach to criticism of the communications which have been laid before us, or to make any distinction as to the merits of their respective authors. Every one who contributes however small an item to our store of botanical knowledge, deserves the thanks of the Society, were it for nothing more than the interest which he thus manifests in our meetings. I am sure, however, that with perfect unanimity you will pardon me if I make one exception as to assigning merit to our contributors, by expressing in my own name, and I am sure I may say in yours, how much, both individually and collectively, we are indebted to my colleague, Professor Balfour, to whom the Society owes its existence, and who has never for a moment wavered in his zeal and industry in laying hold on every side, and collecting from every quarter, whatever he thought would interest and inform us. Besides many interesting bits of botanical information culled by him from his extensive correspondence, and his notices of the flowering of *Pandanus odoratissimus*, and his description of the fruit and seed of the brilliant *Clerodendron Thomsonæ*, we may, I am sure, ascribe to Professor Balfour, indirectly, many of those contributions by younger members

who have been stimulated to botanical study by their zealous and energetic teacher. Let me, in reference to the other contributors to our Transactions, briefly recall to your memory the leading features of the papers which were read to us last Session. In the department of vegetable organography and physiology, we had Dr Alexander Dickson, who has already so creditably distinguished himself in this field, laying before us his careful observations on the embryogeny of *Tropæolum majus*, regarding which I shall only say that it would be well if, in similar researches, all authors would as conscientiously as he does, refrain from eking out their delineations of structure by adding anything from memory to what they have actually under their eye when they make their drawings. It is quite a legitimate proceeding to put down diagrammatically what an organographist may feel assured is the actual relation of parts in any organism which he has been studying, provided he takes care to make it plain that his drawing is truly a diagram; but it is a disheartening and discouraging thing to a less experienced observer to find a drawing given of what seems to be a very plain structure, which he finds himself unable to make out, though, according to the paper before him, it ought to be easily recognised. We had also before us Mr Sadler's remarks on the Bursting of the Spathe of the *Seaforthia*, in which he was unable to obtain any evidence of the production of a sound as stated to occur in the native country of the palm; and we had also the paper on the propagation and irritability of *Drosera* and *Dionæa*, and the narrative of experiments on the Fertilisation of *Orchids* by Mr John Scott. To the last of those papers in particular I listened with very great pleasure when it was read to the Society, not only because the paper was interesting in itself, but because it afforded a convincing proof of the value of the school of instruction which we possess in our Botanic Garden, where we have in valuable combination the extensive cultural establishment, so ably superintended by Mr M'Nab, and the scientific laboratory and class-room of Professor Balfour. I cannot but think it highly creditable to the whole establishment, as well as most meritorious on the part of the author, that such papers should emanate from one who is engaged in the work of practical gardening.

Among the organographic papers laid before the Society there were two to which, as representatives of a class of communications, I would invite attention. The papers on the Contractile Filaments of the Anthers of Thistles, by Cohn of Breslau, and on the Perigynium of the genus *Carex*, by Wesmael of Vilvorde—and with these I may notice, though belonging to descriptive botany, M. De Candolle's paper on the Character of the Oaks, drawn from the annual or biennial maturation of the fruit—were not communications put originally before the scientific world through this Society, but were translations of the authors' papers, Cohn's being translated by Dr Dickson, and De Candolle's by Dr Balfour. I make these remarks, not with the intention of depreciating such papers, because we have not, as it were, the scientific copyright of them, but I notice them for a precisely opposite reason,—viz., to thank the translators for bringing before us foreign papers which might otherwise escape our observation. But I wish to go a little further. I venture to suggest that this is a method of contributing to the Society's proceedings which might be not only extended but systematised, and I would throw out the hint that some of our young enthusiastic botanists might in this way do us a service of no little magnitude. If by an arrangement among themselves, a few of them who are conversant with European languages, would divide the labour of inspecting the foreign scientific periodicals—one taking organography, another descriptive botany, and a third the economic uses of plants, and would give us, perhaps quarterly, a report of what is going on abroad, they would not only convey much useful information to the attending Fellows of the Society, but would make our Transactions doubly valuable to those who are absent from our meetings. They would thus furnish them with a periscope of what is doing in botany, and so make our Transactions equivalent to a botanical journal, which our periodical literature does not possess. In the department of descriptive botany, besides the papers of Dr Balfour and M. de Candolle, already mentioned, the papers on *Lemania variegata* (Agardh), and on the Canadian Equisetums, by Professor Lawson, the Rev. T. Salwey's elaborate paper on new and rare British Lichens, and Professor Babington's commentaries on *Cyperaceæ*, we have a continu-

ation of Dr Carrington's careful investigations of the various orders of Cryptogams, and the fruits of the unexhausted and apparently unexhaustible diligence of our celebrated resident fellow Dr Greville, in working out and describing the exquisite Diatoms. Of these organisms, the wondrous variety, elegant though often strange forms, and most minute but regular and beautiful markings, force home upon even the most careless observer the marvels of the Creator's workings, and make us feel that, not metaphorically, but positively, the hairs of our head are numbered. The Society had reason to congratulate itself on the fact that its Transactions have been the medium of laying before the scientific world so much of the valuable labours of Greville, Babington, and Carrington. In the department of geographical distribution, we have as usual had many contributions made to us in the form of notices of local floras and of new habitats for rare species. Another holiday season having now passed, in which, doubtless, many of our younger active members have been afield with the vasculum, we may expect in the ensuing session more notices of this kind. They are in themselves isolated facts, but are not on that account to be undervalued. It is only by the collecting of these from all quarters that we can acquire the means of solving the many curious problems as to the geographical distribution of plants which yet wait for solution. I would only on this subject make use of my opportunity of now addressing you to put in a plea for habitats—not for noting them only, but for preserving them. It is not necessary for the authentication of a new station that the plant should be gathered and dried. A great deal may be done by a pencil and note-book, and by a sharp pair of eyes, even amidst the velocities of a railway train, in the way of observing and noting the flora of a district. Let us bear in mind that in a country like Britain, advancing as it is in cultivation, many causes are at work to destroy native vegetation. Whilst, as men of business moving from place to place, we cannot but rejoice in the facilities which the navvy's spade has laid open to us, and while as " fruges consumere nati," we must rejoice to see corn and turnip taking the place of carex and sphagnum, we cannot, as botanists, forget that " permanent way" and tile drains are sadly inimical to our native plants, and we

ought therefore to bear in mind that, provided we take all due security that there is no mistake as to the identity of a plant, there is no need in putting a habitat on record that we should obliterate it to enrich our private collections. In the department of the economic uses of plants, we have had before us some subjects of much interest. It is to be hoped that Professor Archer will from time to time lay before us those notices of the economic uses of plants which his position as Director of the Industrial Museum may enable him to present us, and of which his account of *Paullinia sorbilis* was an interesting example. We have also had before us as botanists three subjects which at present attract the notice not merely of the scientific but of the political world. The jealousy of us barbarians which characterises the perturbed empire of the Brother of the Sun and Moon, has rendered it almost a necessity for Britain to do something towards securing a full supply of that refreshing leaf, which has now, from a luxury, become a necessary of British life. It is curious to note the rise of the consumption of this herb. Mr Pepys, in his diary, 26th September 1661, says,—" I sent for a cup of tea (a choice drink) of which I had never drank before." In 1662 the East India Company brought two pounds two ounces of the tea as a present to his Majesty, and in 1667 they gave their first order to their agent to import it. He was to send home 100lb of the best tea he could get. In 1862 the importation amounted to 109 millions of pounds. The success of the tea cultivation in India is an established fact. Large tracts of country are now planted with it. The produce is of excellent quality, and that it does not seem to be an unprofitable culture, may be inferred from the fact, that Mr Jameson of Saharunpore writes to Dr Balfour, that he has sold one Government experimental tea farm in the north-west provinces for the substantial sum of L.10,000, while he expects, with three lots more, to realise an additional L.60,000! Not less interesting to us as a manufacturing country is the question of the production of cotton in our own colonies and other lands, which was brought before us in the form of abstracts of Mr Markham's communications to the Agri-Horticultural Society of Madras. So long as hideous fratricidal war continues to irrigate the valleys of the Potomac with blood, the question as to where

Lancashire and Glasgow are to get the raw material, must be of the deepest interest to Britain; but even were America speedily at peace—a consummation for which I fear we have more devout wishes than well-founded expectations—cotton cultivation in other than American lands will not lose its interest; for we have, from the political events across the Atlantic, learned at least this lesson, which I hope we will not soon forget, that it is unsafe for us to be dependent for the raw material of any of our great industries on any one country, however productive. Another lesson of a similar kind has also been taught us from across the Atlantic. The recklessness of the South American cascarilleros, or bark-gatherers, in destroying the Cinchona trees, whilst they might have collected their medicinal barks by less destructive methods, has more than once led the governments of the country temporarily to interdict the gathering of the barks, and has thus raised the price of these valuable commodities to exorbitant amounts. To Britain, whose fleets and armies are in every quarter of the globe, and often in territories infected by the dangerous fevers of miasmatic origin, a full supply of the great remedy, quinine, becomes indispensable; and considering the uncertain political state of the South American republics, to say nothing of the chances in time of the more valuable barks there becoming exhausted, it has become imperative on Britain to take steps for making herself no longer dependent upon one foreign quarter of the world for this precious guardian of the health of our sailors and soldiers. The efforts that have been made to accomplish this have been at length, after many difficulties, so far successful that we have many species, including the pre-eminently valuable *Cinchona Calisaya* now in cultivation in India, as was communicated to us last session in Dr Anderson's interesting letter to Dr Balfour, written from Darjeeling. It is true that we are neither the first, nor as yet the most successful cultivators of Cinchona in the East. The Dutch have done much in this matter in Java; but now that we have made a beginning, and considering that our Himalayas offer us the kind of localities in which Cinchonas thrive, we need, I think, be in no doubt that we shall in time have abundant supplies of quinine from our own eastern empire. Lastly, amidst

many other subjects which time does not permit me to notice, let me recall to your remembrance, the continuation of those interesting registers of plants flowering in the Botanic Garden at particular periods of the year, with which Mr M'Nab is in the habit of favouring us. When these have been continued for a number of seasons we may expect to receive some interesting information from them, when they are collected and studied in connection with the meteorological history of the country.

I should like to have added to this *resumé* of our own Transactions some notice of what has been doing elsewhere in botanical science. It is vain for me to attempt this. My studies have been too much in other directions, and my botanical reading too desultory, to entitle me to offer, even if your patience would accept of it, any sketch of the progress of botany during last year. I can only venture to call your attention to one or two papers which have come under my own notice. Mr Gulliver, of London, whose accuracy as an observer challenges attention to everything which emanates from his pen, has, in a series of communications to the Annals of Natural History, called attention to the subject of Raphides, and to their destribution in the vegetable kingdom. Using the term raphides generically to express the crystalline bodies which occur in the cells of plants, he points out that this word, though etymologically applicable to them when needle-shaped, does not properly apply when, as is so commonly the case, they are in more or less globular masses; and for these, therefore, he proposes the compound word, expressive of their form, Sphæraphides. He calls attention to their general occurrence in phanerogams, indicates their special appearance in some natural orders, as *Onagraceæ*, and suggests that, in some instances, they may furnish distinctive characters. I am hardly disposed to expect that the occurrence, or absence, or peculiar appearance of sphæraphides will ever be able to rank in value with characters drawn from the organs; but we never can have too many means of diagnosis, and certainly some of the facts mentioned by Mr Gulliver, if confirmed by further observations, are very curious. Then he points out the fact, that whilst *Rubiaceæ* abound in raphides, the closely-allied *Capri-*

foliaceæ do not contain them. In certain circumstances, however, the detection of raphides might be important, as they could easily be made out when we have at command only fragments of a plant; and they seem to occur in all stages of growth of the plants which contain them, as Gulliver has detected them even in the seed-leaves. I notice these papers of Mr Gulliver chiefly in the spirit in which he concludes one of them, as suggesting a curious, though rather extensive, subject of inquiry for other observers, but one which, to any one accustomed to the use of the microscope, does not present any difficulty, though requiring some labour and patience. What can we learn, however, without these? The Society will take pleasure in knowing, that our former resident Fellow, Mr Andrew Murray, now in London, has, in the Proceedings of the Royal Horticultural Society, published an interesting monograph on the *Coniferæ* of Japan; and the mention of this natural order reminds me to notice the Messrs Lawson's noble work on the Pines, now in course of publication—a work which, in size, luxury of type, and splendour of illustration, is without a rival, and which, in the scientific world, is the fitting counterpart of the munificent hospitality in the municipal world, which the leading partner of that firm exercises, in the capacity of Chief Magistrate of our city. I must, however, not trespass too much on your patience, and will content myself with merely referring the members to the bibliography of the October number of the Natural History Review, and to other periodicals, for notices of many interesting papers that have proceeded from the pens of British and Continental botanists.

I now return to our own Society, for the purpose of briefly noticing the inroads which, during last year, death has made upon our number. Whilst we have rejoiced to welcome among us many of those who with youthful ardour have embraced the study of botany, we have to regret the loss of several Fellows of the Society who had long been devoted to the cultivation of our science. I take the Fellows, of whose recent decease I am aware, in alphabetical order.

Francis Appavoo, a native surgeon on the Madras estab-

lishment, was a stranger to us personally, but was made known to us by our estimable Fellow, Dr Hugh Cleghorn. Appavoo entered the public service as a dresser, and had the good fortune to do duty under Dr Cleghorn, then a district surgeon in Madras. It is not surprising that, under so enthusiastic a botanist, an intelligent native, like the subject of the present notice, should have acquired a taste for the favourite science of his superior officer, and accordingly we find that Appavoo soon became so great a proficient in that department of science, as to be appointed an assistant to Dr Cleghorn in the teaching of Materia Medica and Botany in the Madras Medical College. This appointment he continued to hold till 1859, having in the meantime, after a highly successful examination, been nominated a native surgeon. As a teacher, he was distinguished by remarkable ability, and by a courteous and considerate though firm demeanour to the students. In 1859 he resigned his appointment at the College to occupy a post in the Forest Department under Dr Cleghorn, which he filled till the period of his death, which took place, after a short illness, on 21st January last. His literary labours were confined to the compilation and correction of scientific works referring to the botany and materia medica of India. From the number and social position of those who followed his remains to the grave, he appears to have gained the esteem and regard of all those with whom he was brought in contact; and he affords a good example of the success which has been obtained by the Madras College in educating natives for the medical profession. Appavoo was admitted an Associate of the Society on 13th December 1860.

John Wright Brown, whose obituary by Professor Balfour has already appeared in our Transactions, was the son of the Rev. Charles Brown, of this city, and was born on the 19th January 1836. For many years he acted as assistant in the Herbarium Department at the Royal Botanic Garden. He was well acquainted with the natural orders of plants, and gave most essential assistance in the arrangement of the collection. He had a happy and genial disposition, and was most obliging and kind. He died at 39 George Square on 23d March last, aged twenty-seven. He

was elected an Associate of our Society on 4th December 1856.

Dr John Coldstream, of this city, died at Gilsland, in Cumberland, on 17th September, in the sixtieth year of his age. He graduated in medicine at this University in 1827, and became a fellow of the Royal College of Physicians in 1845. He was for many years in practice in Leith, but eventually established himself in Edinburgh, where he enjoyed in his professional capacity a large share of the confidence of his fellow-citizens. In early life Dr Coldstream devoted himself keenly to natural history—zoology being his favourite department. He was a member, and at one time president, of the Royal Physical Society; and he was also a member of the Wernerian Society up to the period of its dissolution in 1858, when he became a Fellow of the Botanical Society. Dr Coldstream contributed to some extent to the literature of natural and medical science. He wrote several articles in the Cyclopedia of Anatomy and Physiology, besides an account of hourly thermometrical observations in the Wernerian Transactions for 1823; a paper on *Limnoria terebrans* in the Edinburgh New Philosophical Journal, 1834, and a narrative of a case of Catalepsy in the Edinburgh Medical Journal, 1854; and he finally, in 1860, was the author of a work highly characteristic of his own turn of mind, entitled The Merchant the World's Benefactor. There were other matters, however, which occupied during many years of Dr Coldstream's life the chief place in his thoughts. Ever distinguished by deep convictions of Christian truth, Dr Coldstream took a warm interest in everything which tended to advance the spiritual welfare of his fellow-men; and finding in the establishment of the Medical Missionary Society of Edinburgh a field of common action for religion and its handmaid medicine, he became secretary of the Society, and continued to hold this office at the time of his death. This is not the time or place to dwell upon the union of zeal and judgment with which he promoted the cause of medical missions. The Medical Missionary Society will now know how difficult it will be to supply the vacancy. Nor is this the occasion to enlarge upon Dr

Coldstream's personal character as a Christian man; but I may be permitted to say this of him, that his leading characteristics were earnestness of purpose and catholicity. He was one of those men, quiet, unpretending, but always at work, about whose sincerity, and devotedness to what he was engaged in, no one could for a moment entertain a doubt. He seemed to carry others with him as much by the attraction of his own character as by the power of his unwearied industry in the duties which he undertook; and so entirely free was he from any tendency to sectarianism, that I can for my own part say, after many years' acquaintance with him, that had I not known *aliunde* that he was a member of the Free Church, I never would have learned the fact from anything that ever fell from himself. In the business of the Botanical Society he can hardly be said to have taken a part. He never was a robust man, and during most of the period, since he came to us from the Wernerian Society, his health was not good. He consequently was not so much known to many of the Fellows as we could have wished him to have been; but those who had the privilege of knowing him will long cherish the recollection of him, as a typical example of a large-hearted, earnest-minded, Christian man.

The Rev. H. W. Coleman, M.A., of Hertford, lately one of the masters of the Grammar School of Ashby de la Zouch, and formerly of Christ's Hospital, died at Burton-on-Trent, 12th December 1863. Mr Coleman was an accurate British botanist. Amongst the additions which he made to the British Flora are *Œnanthe fluviatilis* and *Carex Boenninghausiana*. In conjunction with Mr Webb, he published a Flora of Hertfordshire, in which the county is divided into districts, and notice is taken of the connection between the soils of the localities and the plants found in them. He devoted much attention to the geographical distribution of British plants, and communicated some papers on this subject to the Phytologist. He became a non-resident Fellow of the Society on 10th June 1841.

Dr Deuchar, of Morningside, was a member of the medical profession, and at an early period of his life was in business as a druggist in Edinburgh. He afterwards became a

lecturer on chemistry. He took an interest in popular education, and was, about the time of its establishment, a director of the now highly successful Philosophical Institution of Edinburgh. Dr Deuchar of late retired on his property at Morningside. He joined the Botanical Society at the dissolution of the Wernerian in 1858, and died last spring.

Mr William Groves Perry, who became a Fellow of our Society on 12th November 1840, and was a contributor to the herbarium, died at Warwick, 25th March 1863. He was an early contributor to Loudon's Magazine of Natural History. In 1820 he published The Botanist's Guide through the County of Warwick, and was preparing a second edition of this book at the time of his death. He was honorary secretary of the Warwickshire Natural History and Archæological Society.

James Rome, LL.B., M.A., who became a Fellow of this Society in January 1862, died 8th May 1863, at Woodlands, Hamilton, where he was in business as a partner of the firm of Aikman and Rome, writers. He was a young man of cultivated mind, as evidenced by his possession of the degrees of bachelor of laws and master of arts, and died at the early age of twenty-five.

I have thus rapidly gone over a few particulars of the history of our Society during the last session. I have to apologise for the imperfect manner in which I have addressed you from the chair. I have to repeat the thanks which I offered to you last year when you did me the honour to elect me your president; and I have now, in retiring from office, to express my hope and belief that the Society will continue to receive fresh accessions to its numbers from the young botanists of our University; and that they, along with the present active members, will by their contributions maintain the credit of the Society and the value of its Transactions.

The following Communications were then read :—

I. *Notes on the Fertilisation of Orchids.* By WILLIAM RUTHERFORD, M.D., President of the Royal Medical Society, Resident Physician Royal Infirmary. (Being a portion of a thesis, for which a gold medal was awarded by the Medical Faculty of the University of Edinburgh at the Graduation in 1863.)

Mr Darwin, in the introduction to his admirable work on "The Fertilisation of Orchids," states, that his chief reason for writing the work was, "to show that the contrivances by which orchids are fertilised, have for their main object the fertilisation of each flower by the pollen of another flower;" and to show that, in his "Origin of Species," he had good grounds for expressing his belief in what he regards as an apparently universal law—viz., "That no hermaphrodite fertilises itself for a perpetuity of generations, an occasional cross with another individual being required." He, moreover, expresses the hope, that his researches may stimulate others to inquire into the habits of our native species.

During the past summer (1862), I spent some time in the examination of a considerable number of orchids, with a view to ascertain whether or not Mr Darwin's observations were accurate, and the conclusions at which he had arrived correct. The points which I especially wished to test, were, 1*st*, Is insect agency essential for their fertilisation? 2*d*, Is a flower fertilised by its own pollinia, or by those of other flowers? As regards the first of these, Mr Darwin says, that in every orchis, with the exception of the bee orchis and *Cephalanthera grandiflora*, insects are required to remove the pollinia, and apply them to the stigma; and with regard to the second point, he says,—that although in some cases the pollinia may be applied to the stigma of the flower from which they are taken, yet in all they may be—and most generally they are—applied to the stigmas of other flowers; farther, in some flowers—the marsh Epipactis, for

example—the pollinia are removed only when the insect retires from the flower.

Sprengel, in 1795, and Robert Brown, in 1833, though the latter was not without his doubts on the subject, both expressed their belief in the necessity for insect agency; and many others have concurred with the opinion; but Darwin was the first to show that the necessity for insects, which was previously considered to be confined to a few, is almost universal. My observations, so far as they have extended, have most thoroughly convinced me of the truth of Mr Darwin's statement. But I must here mention, to prevent any misunderstanding, that I have examined four species only,—for the district in which I resided contained only these four species, although they were severally represented by large numbers of individuals, so that I was able to make a pretty thorough examination of each species. I was staying in a part of Kent where *Orchis maculata* and *Cephalanthera grandiflora* were especially abundant; and *Gymnadenia conopsea*, and *Orchis pyramidalis*, to a lesser degree. I examined 1175 flowers of *Cephalanthera*, 1000 of *Orchis maculata*, 244 of *Gymnadenia conopsea*, and 60 of *Orchis pyramidalis*, in all 2479 flowers. This number may seem very large; but it must be remembered, that the flowers grew abundantly in the locality; and I had but little difficulty in procuring them. All the plants grew near, or in, woods, so that they were most favourably situated for visitation by insects. Mr Darwin says, that on one occasion only has he seen an insect capable of carrying away the pollinia visit an Orchis. I have been more fortunate; for I have repeatedly observed, especially on warm, cloudy days, lepidopterous insects paying their visits; and on one occasion I actually saw an insect remove the pollinia. Although Mr Darwin thinks that an insect does not confine its visitations to one particular species, but embraces several,—an opinion which he has shown to be true in the case of some one or two insects,—I must say that *Orchis maculata* and *Cephalanthera grandiflora*, although growing together, were visited by totally distinct insects, and either species was only visited by one kind of insect.

This fact is certain regarding the fertilisation of three

out of these four species,—*self-fertilisation is impossible,*—the pollinia must be removed from the flower and applied to the stigma of either the same or another flower. In by far the greater majority of the flowers, the pollinia, where these were single, were both removed, and in only a few of these were the ovaries non-fertilised. Sometimes I found the heads of pollinia sticking to the stigmas: this was rare, however; more frequently I found bundles broken off from the pollinia adhering to the stigma, and in some of these instances the pollinia remained in the same flower untouched, showing conclusively, that these flowers had been fertilised by the pollinia of other flowers. The flowers I examined were generally *old*, with the viscid discs and stigmas quite dry, so that no farther change could take place in the fertilisation of such flowers. Out of 1304 flowers, 953 had both pollinia removed, of which 895 were fertile and 58 were non-fertile. From this it appears, that although the pollinia may have been removed from the flowers, these were sometimes non-fertile. This is, because the insect has carried away the pollinia without pushing them against the stigma, and because the flowers have never been visited by insects having pollinia on their probosces. If such flowers could ever have become fertilised (most were old), it must have been by the pollinia of other flowers.

In 212, both pollinia were still remaining, although the flowers were mostly dry and shrivelled. Of these 119 were fertile, and 96 were non-fertile, so that although these flowers are incapable of self-fertilisation, the flowers are oftener fertilised than not. Insects with pollinia attached to their probosces visited the flowers and fertilised them, although they did not remove the pollinia. Had the flowers grown in a less wooded district, where insects are more scarce, many more of them would have had both pollinia remaining, and fewer of these would have been fertilised. Observe (*see* the Table at the end) how different is the case of *Cephalanthera grandiflora*, which is capable of self-fertilisation, although to a small degree: only 39 out of 1175 flowers had both pollinia remaining, and these, nevertheless, were *all* fertile; while of the 1128 which had both pollinia removed, only 8 were non-fertile. In the two other species which had the pollinia

separate, that is, unattached at the base to one another, the right pollinium was removed rather oftener than the left, a fact which would be difficult to explain. Of the 166 flowers which had only one pollinium removed, 142 were fertile and 24 non-fertile, showing that where only one pollinium is removed, the flower is not so certainly fertilised; in short, the insects have not visited them so frequently.

It is unnecessary for me to comment further upon the following Table, but I may shortly state, that it fully bears out Mr Darwin's conclusions; it establishes nothing new, but simply places beyond doubt very important opinions advanced by Darwin, among which the following are the most important:—1*st*, Insect agency is necessary for fertilisation; 2*d*, Crossing of the individuals of a species is not only permitted, but all the arrangements seem especially adapted to bring about such a result.

One would suppose that hybrids ought to be very common if Mr Darwin's opinion were correct,—that one insect visits several species of orchids,—while it is well known that orchidaceous hybrids are extremely rare. From all that I have observed, I believe it to be the rule that each species has its special visitor, and that the same insect visits several species, to be the exception. I dare not, however, speak too positively on this point, for my observations have not been extensive.

Finally, it may seem superfluous for me to draw attention to the beautiful and laborious investigations contained in Mr Darwin's work on orchids; but only those who have carried on such researches are able to estimate the severe and prolonged labour which they entail.

Name.	Number of Flowers examined.	Both Pollinia remaining.		Both Pollinia removed.		One Pollinium removed.			
						The Right.		The Left.	
		Fertile.	Non-fertile.	Fertile.	Non-fertile.	Fertile.	Non-fertile.	Fertile.	Non-fertile.
Orchis maculata	1000	50 2 of these young.	28 12 of these young.	765	47 15 of these young.	53	3	44	10
Gymnadenia conopsea	244	54	29	96	9	30	7	15	4
Orchis pyramidalis	60	15	39	34	2	Pollinia attached to one another by their bases.			
Totals,	1304	119	96	895	58	83	10	59	14
		215		953		93		73	
Cephalanthera grandiflora	1175	39	None.	1128	8.	Pollinia attached to one another by their bases.			

Synopsis of Canadian Ferns and Filicoid Plants. By GEORGE LAWSON, Ph.D., LL.D., Professor of Chemistry and Natural History in Dalhousie College, Halifax, Nova Scotia.

The following Synopsis embraces a concise statement of what is known respecting Canadian ferns and filicoid plants. Imperfect as it is, I trust that it will prove useful to botanists and fern fanciers, and stimulate to renewed diligence in investigation. The whole number of species enumerated is 74. Of these 11 are doubtful. Farther investigation will probably lead to the elimination of several of the doubtful species, which are retained for the present with a view to promote inquiry; but a few additional species, as yet unknown within the boundaries of Canada, may be discovered. The above number (74) may be regarded, then, as a fair estimate—perhaps slightly in excess—of the actual number of ferns and filicoid plants existing in Canada. The number certainly known to exist, after deducting the species of doubtful occurrence, is 63.

The number of species described in Professor Asa Gray's exhaustive "Manual," as actually known to inhabit the northern United States, that is to say, the country lying to the south of the St Lawrence River and great lakes, stretching to and including Virginia and Kentucky in the south, and extending westward to the Mississippi River, is 75. This number does not include any doubtful species.

The number described in Dr Chapman's "Flora," as inhabiting the Southern States, that is, all the states south of Virginia and Kentucky and east of the Mississippi, is 69.* From these statements it will be seen that we have our due share of ferns in Canada.

The whole number of ferns in all the American States, and the British North American Provinces, is estimated, in a recent letter from Mr Eaton, as probably over 100.

In the British Islands there are about 60 ferns and filicoid

* Mr D. C. Eaton, M.A., is author of that portion of Dr Chapman's "Flora" which relates to the ferns.

plants. In islands of warmer regions the number is greatly increased. Thus Mr Eaton's Enumeration of the true ferns collected by Wright, Scott, and Hayes, in Cuba, embraces 357 species. The proportions of ferns to phanerogamous plants in the floras of different countries are thus indicated by Professor Balfour, in the "Class Book of Botany," page 998, § 1604:—"In the low plains of the great continents within the tropics ferns are to phanerogamous plants as 1 to 20; on the mountainous parts of the great continents, in the same latitudes as 1 to 8 or 1 to 6; in Congo as 1 to 27; in New Holland as 1 to 26. In small islands, dispersed over a wide ocean, the proportion of ferns increases; thus, while in Jamaica the proportion is 1 to 8, in Otaheite it is 1 to 4, and in St Helena and Ascension nearly 1 to 2. In the temperate Zone, Humboldt gives the proportion of ferns to phanerogamous plants as 1 to 70. In North America the proportion is 1 to 35; in France 1 to 58; in Germany 1 to 52; in the dry parts of South Italy as 1 to 74; and in Greece 1 to 84. In colder regions the proportion increases; that is to say, ferns decrease more slowly in number than phanerogamous plants. Thus, in Lapland, the proportion is 1 to 25; in Iceland 1 to 18; and in Greenland 1 to 12. The proportion is least in the middle temperate zone, and it increases both towards the equator and towards the poles; at the same time it must be remarked, that ferns reach their absolute maximum in the torrid zone, and their absolute minimum in the arctic zone."

Canada consists of a belt of land, lying to the north of the St Lawrence River and the great lakes. By these it is separated, along nearly the whole extent of its south-eastern and western boundaries, from the northern United States, which thus enclose Canada on two sides. A striking resemblance, amounting almost to identity, is therefore to be looked for in the floras of the two countries. Yet species appear in each that are absent in the other.

The species of ferns and filicoid plants which are certainly Canadian, number . . . 63
Of these there inhabit the Northern States, . 58
Do. do. Southern States, . 38
Do. do. Europe, . . 36

The following table is designed to show some of the geographical relations of our Canadian ferns. The first column (I.) refers exclusively to the occurrence of the species within the Canadian boundary. The plus sign (+) indicates that the species is general, or at least does not show any decided tendency towards the extreme eastern or western, or northern or southern parts of the province. The letters N, S, E, W, &c., variously combined, indicate that the species is so limited to the corresponding northern, southern, eastern, or western parts of the province, or at least has a well-defined tendency to such limitation. The mark of interrogation (?) signifies doubt as to the occurrence of the species. The second column (II.) shows what Canadian species occur also in the Northern States, that is the region embraced by A. Gray's Manual; and the third column (III.) those that extend down south into Chapman's territory. The fourth column (IV.) shows the occurrence of our species in Europe; C in this column indicating Continental Europe, and B the British Islands. The fifth or last column (V.) shows the species that extend northwards into the Arctic circle—35 in all, of which, however, only 14, or perhaps 15, are known to be arctic in America. Am, As, Eu, and G indicate respectively Arctic America, Arctic Asia, Arctic Europe, and Arctic Greenland. The information contained in the last column has been chiefly derived from Dr Hooker's able Memoir in the Linnean Transactions (vol. xxiii. p. 251).

Hitherto no attention whatever has been paid, in Canada, to the study of those remarkable variations in form to which the species of ferns are so peculiarly liable. In Britain, the study of varieties has now been pursued by botanists so fully as to show that the phenomena which they present have a most important bearing upon many physiological and taxological questions of the greatest scientific interest. The varieties are studied in a systematic manner, and the laws of variation have been to a certain extent ascertained. And as the astronomer can point out the existence of a planet before it has been seen, and the chemist can construct formulæ for organic compounds—members of homologous series—in anticipation of their actual discovery, so,

in like manner the pteridologist now studies the variations of species by a comparative system, which enables him to look for equivalent forms in the corresponding species of different groups. Studies so pursued are calculated to evolve more accurate and definite notions as to the real nature of species, and the laws of divergence in form of which they are capable. I would therefore earnestly invite Canadian botanists to a more careful study of the *varieties* of the Canadian ferns, after the manner of Moore and other European leaders in this comparatively new path. The elasticity, or proneness to variation, of the species in certain groups of animals and plants has been somewhat rashly used to account for the origin of species, by what is called the process of variation. It seems to tell all the other way. Innumerable as are the grotesque variations of ferns, in forkings, and frillings, and tassellings, and abnormal veinings, &c. (see the figures in Moore's works), we do not know of a single species in which *such* peculiarities have become permanent or general, that is *specific*, so that the species can be traced back to such an origin; surely something of the kind would have happened had all species originated by a process of variation.

*Tabular View of the Distribution of Canadian Ferns and Allied Plants over certain parts of the Northern Hemisphere.**

NAME.	I. Canada.	II. Northern States.	III. Southern States.	IV. Europe.	V. Arctic Circle.
POLYPODIACEÆ.					
1. Polypodium vulgare, . .	+	+	+	C.B.	Eu.
2. P. hexagonopterum, . . .	+	+	+	...	...
3. P. Phegopteris, ...	+	+	...	C.B.	Eu. G.
4. P. Dryopteris, ...	+	+	...	C.B.	Eu. Am. G.

* In the above Table, the doubtful species are included; but all reference to varieties is omitted.

Name.	I. Canada.	II. Northern States.	III. Southern States.	IV. Europe.	V. Arctic Circle.
5. P. Robertianum, ...	+	+	...	C.B.	...
6. Adiantum pedatum, . . .	+	+	+	...	...
7. Pteris aquilina, ...	+	+	+	C.B.	Eu.
8. Pellæa atropurpurea, . . .	S.	+	+	...	...
9. Allosorus Stelleri, . . .	+	+	...	...	...
10. Cryptogramma acrostichoïdes,	W.W.	...	...	?	Am.
11. Struthiopteris germanica, .	+	+	...	C	Eu.
12. Onoclea sensibilis, . . .	+	+	+	...	...
13. Asplenium Trichomanes, .	+	+	+	C.B.	...
14. A. viride, ...	N.E.	...	...	C.B.	Eu. G.
15. A. angustifolium, ...	S.W.	+	+	...	...
16. A. ebeneum, ...	+	+	+	...	...
17. A. marinum, ...	E. ?	...	...	C.B.	...
18. A. thelypteroides, . . .	+	+	+	...	...
19. A. montanum, ...	?	+	+	...	...
20. A. Ruta-muraria, ...	?	+	+	C.B.	Eu.
21. Athyrium Filix-fœmina, .	+	+	+	C B	Eu.
22. Woodwardia virginica, . .	S.W.	+	+	...	...
23. Scolopendrium vulgare, . .	W.W.	+	...	C.B.	...
24. Camptosorus rhizophyllus, .	W.	+	+	...	...
25. Lastrea dilatata, ...	+	+	+	C.B.	Eu. Am.
26. L. marginalis, ...	+	+	+	...	...
27. L. Filix-mas, ...	? ?	...	...	C.B.	Eu. G.
28. L. cristata, ...	+	+	...	C.B.	...
29. L. Goldieana, ...	W.	+	...	...	...
30. L. fragrans, ...	N.W. ?	+	...	...	As.Am.G.
31. L. Thelypteris, ...	+	+	+	C.B.	...
32. L. Nov-Eboracensis, . . .	+	+	+	...	...
33. Polystichum angulare, . .	+	+	...	C.B.	Eu.
34. P. Lonchitis, ...	N.W.	+	...	C.B.	Eu. Am. G.
35. P. acrostichoides, ...	+	+	+	...	...
36. Cystopteris fragilis, . . .	+	+	+	C.B.	Eu.Am.G.
37. C. bulbifera, ...	+	+	+	...	...
38. Dennstædtia punctilobula, .	+	+	+	...	...
39. Woodsia Ilvensis, . . .	+	+	+	C.B.	Eu. As. Am. G.
40. W. alpina, ...	+	...	...	C.B.	Eu. G.
41. W. glabella, ...	+	+	...	...	Am.
42. W. obtusa, ...	?	+	+	...	...
43. Osmunda regalis, ...	+	+	+	C.B.	...
44. O. cinnamomea, ...	+	+	+	...	...
45. O. Claytoniana, ...	+	+	+	...	...
46. Schizæa pusilla, ...	?	+	...	...	...

Name.	I. Canada.	II. Northern States.	III. Southern States.	IV. Europe.	V. Arctic Circle.
Ophioglossaceæ.					
47. Botrychium virginicum, .	+	+	+	...	Eu. G.
48. B. lunarioides, ...	+	+	+	?	...
49. B. Lunaria, ...	N.	...	...	C.B	Eu. G.
50. Ophioglossum vulgatum, .	?	+	+	C.B.	Eu.
Lycopodiaceæ.					
51. Plananthus Selago, . . .	N. ?	+	+	C.B.	Eu. As. Am. G.
52. P. lucidulus, ...	+	+	+	C.	...
53. P. alopecuroides, ...	? ?	+	+	...	...
54. P. inundatus, ...	+	+	+	C.B.	...
55. Lycopodium clavatum, . .	+	+	+	C.B.	Eu. G.
56. L. annotinum, ...	+	+	+	C.B.	Eu.Am.G.
57. L. dendroideum, ...	+	+	+	. .	...
58. L. complanatum, ...	+	+	+	C.	Eu. As.
59. Selaginella spinulosa, . .	N.E.	+	+	C.B.	Eu. G.
60. Stachygynandrum rupestre, .	+	+	+	...	...
61. Diplostachyum apodum, . .	+	+	+	...	...
Marsileaceæ.					
62. Azolla caroliniana, . . .	S.	+	+	...	...
63. Salvinia natans, ...	? ?	...	+	C.	...
64. Isoetes lacustris, ...	+	+	+	C.B.	Eu. G.
Equisetaceæ.					
65. Equisetum sylvaticum, . .	+	+	...	C.B.	Eu.Am.G.
66. E. umbrosum, ...	+	+	...	C.B.	Eu.
67. E. arvense, ...	+	+	...	C.B.	Eu. As. Am. G.
68. E. Telmateja, ...	W.	+	...	C.B.	...
69. E. limosum, ...	+	+	...	C.B.	Eu.
70. E. hyemale, ...	+	+	...	C.B.	Eu.
71. E. robustum, ...	+	+	...	...	...
72. E. variegatum, ...	N.E.	+	...	C.B.	Eu. Am.? G.
73. E. scirpoides, ...	+	+	...	C.	Eu. As. Am. G.
74. E. palustre, ...	N.	...	...	C.B.	Eu. Am.

Nat. Ord. POLYPODIACEÆ.

Polypodium.

P. vulgare, Linn.—Frond linear-oblong or somewhat lanceolate, more or less acuminate, deeply pinnatifid, in some forms almost pinnate; lobes (or pinnæ) linear-oblong, obtuse, often acute, rarely acuminate, entire or crenate or serrate; sori large; very variable as regards outline of the frond, form, &c., of the lobes, and serrature. *P. vulgare*, Linn., A. Gray, Moore, &c. *P. virginianum* of English gardens. *P. vulgare*, var. *americanum*, Hook., Torrey Fl. N. Y., ii. 480.—On rocks in the woods, not rare around the city of Kingston; abundant on the rocky banks of the St Lawrence, in Pittsburg; in the woods at Collins's Bay; and on Judge Malloch's farm, a mile west from Brockville; Gananoque lakes and rivers; Farmersville; Newboro-on-the-Rideau; Toronto; on the great boulder of the Trent Valley, near Trenton; on rocks west from Brockville, outcrop of Potsdam Sandstone at Oxford, and Hull mountains near Chelsea, C.E., B. Billings, jr.; near Gatineau Mills, D. M'Gillivray, M.D.; Mount Johnson, C.E., and Niagara River, P. W. Maclagan, M.D.; Brighton, in the crevice of a rock in a field, and abundant on rocky banks, right bank of the Moira, above Belleville, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; north-west from Granite Point, Lake Superior, R. Bell, jr.; mountain top, near Mr Brydge's house, Hamilton, C.W., Judge Logie; River Rouge and lower end of Gut Lake, W. S. M. D'Urban; Cape Haldimand, Gaspé, John Bell, B.A.; Red River Settlement, Governor M'Tavish; Pied du cap Tourmente, M. L'Abbé Provancher; L'Orignal and Grenville, C.E., J. Bell, B.A. The habitats above cited show that although this fern is not so common in Canada as in Britain, it is nevertheless widely distributed. It is common in New York State, according to Professor Torrey; and in the Northern States generally, according to Professor Asa Gray; rarer in the South, according to Dr Chapman.

P. hexagonopterum, Mich.—Frond triangular in outline, acuminate, pinnate, hairy throughout; pinnæ broadly lanceolate, pinnatifid; lowest pair of pinnæ larger than the others, not deflexed; lobes of the pinnæ linear-oblong or lanceolate, strongly toothed, or almost pinnatifid. The decurrent pinnæ have a tendency to form conspicuous irregular angled wings along the rachis. Stipe not scaly except at the base. Rhizome long, slender, ramifying. Whole plant much larger than *P. Phegopteris*, and quite a different species. *P. hexagonopterum*, Michx., A. Gray, &c. The figure in Lowe's Ferns, vol. i. p. 143, tab. 49, is a little too much like Phegopteris. *P. Phegopteris* γ. *majus*, Hook. Fl. Bor. Amer., ii. p. 258. Hooker's β. *intermedia* of Phegopteris is *connectile*, Willd., which A. Gray refers to *P. Phegopteris*, L. *Phegopteris hexagonoptera*, J. Sm. Cat., p. 17.—Canada, Goldie in Hook. Fl. B. Amer.; Chippawa, C. W., P. W. Maclagan, M.D.; Mirwin's Woods, near Prescott, rare, B. Billings, jr.; near Westminster Pond, London, W. Saunders. Not by any means so general in Canada as in New York State, where, Professor Torrey states, it is common.

P. Phegopteris, Linn.—Frond acutely triangular in outline, acumi-

nate, pinnate; the pinnæ linear-lanceolate, pinnatifid, lowest pair deflexed; lobes of the pinnæ oblong, scythe-shaped, obtuse, approximate, entire; rachis hairy and minutely scaly to the apex of the frond, as well as the mid-ribs of the pinnæ. *P. Phegopteris*, Linn., A. Gray, Moore, &c. *Phegopteris vulgaris*, J. Sm. *P. connectile*, Michx., Pursh Fl. Am. Sept., ed. 2, vol. ii. p. 659.—Canada, Hooker; Black Lead Falls and De Salaberry, west line, W. S. M. D'Urban; Ramsay, Rev. J. K. M'Morine, M.A.; Nicolet, P. W. Maclagan, M.D.; Prescott, damp woods, not common, Osgood Station of the Ottawa and Prescott Railway, also Gloucester, near Ottawa, growing on the side of a ravine, and Chelsea, C.E., B. Billings, Jr; opposite Grand Island, Lake Superior, R. Bell, jr.; L'Orignal and Harrington, J. Bell, B.A.

P. Dryopteris, Linn.—Frond thin, light-green, pentangular in outline, consisting of three divaricate triangular subdivisions, each of which is pinnate, with its pinnæ more or less deeply pinnatifid; pinnules oblong, obtuse, nearly entire; stipe slender and weak, not glandulose. *P. Dryopteris*, Linn., A. Gray, Moore, &c. *Phegopteris Dryopteris*, J. Sm.—Abundant in the woods around Kingston; Ramsay, Rev. J. K. M'Morine, M.A.; very common in woods about Prescott, B. Billings, jr.; Montreal and Nicolet Rivers, C.E., P. W. Maclagan, M.D.; Belleville, common in the woods, J. Macoun; opposite Grand Island, Lake Superior, R. Bell, jr.; River Rouge, Round Lake, Montreal, De Salaberry, west line, and Black Lead Falls, W. S. M. D'Urban; Newfoundland, Labrador; Somerset and St Joachim, M. L'Abbé Provancher; L'Orignal, J. Bell, B.A.

Var. β. erectum.—Frond erect, rigid, with a very stout and very long glabrous stipe (18 inches long); beech woods at Collins's Bay, near Kingston, with the normal form. This variety resembles *P. Robertianum* in general aspect, but is not at all glandulose.

P. Robertianum, Hoffman.—A stouter plant than *P. Dryopteris;* fronds more rigid and erect; rachis, &c., closely beset with minute-stalked glands. *P. Robertianum*, Hoffman, Moore, &c. *P. calcareum*, Sm. *P. Dryopteris*, var. *calcareum*, A. Gray.—Canada, Moore and other authors; United States, Gray and others. This species is commonly spoken and written of as a Canadian Fern. Not having had an opportunity of seeing Canadian specimens, I cannot cite special habitats. The minutely glandulose rachis serves at once to distinguish it.

ADIANTUM.

A. pedatum, Linn.—Stipe black and shining, erect, forked at top, the forks secundly branched, the branches bearing oblique triangular-oblong pinnules. *A. pedatum*, Linn., A. Gray, &c., Lowe's Ferns, vol. iii. pl. 14. Abundant in vegetable soil in the woods around Kingston; woods around the iron mines at Newboro-on-the-Rideau; Farmersville; Toronto; Montreal, Chippawa, Wolfe Island, and Malden, P. W. Maclagan, M.D.; Belleville, in rich woods, abundant, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; Ke-we-naw Point, R. Bell, jr.; at the Sulphur Spring, and common everywhere about Hamilton, Judge Logie; Lake Huron, Hook. Fl. B. A.; De Salaberry, west line, W. S. M. D'Urban; on the Gatineau, near Gilmour's rafting ground, D.

M'Gillivray, M.D.; London, W. Saunders; St Joachim and Isle St Paul, Montreal, M. L'Abbé Provancher; West Hawkesbury and Grenville, C.E., J. Bell, B.A. Apparently common everywhere in Upper Canada. I cannot speak so definitely of the Lower Province. This is one of our finest Canadian ferns; "the most graceful and delicate of North American ferns," says Torrey. It is easily cultivated. Fine as it is in the Canadian woods, I have specimens even more handsome from Schooley's Mountains (A. O. Brodie, Ceylon Civil Service); their fan-like fronds spread out in a semicircle, with a radius of 2½ feet. It is not a variable species in Canada. T. Moore, in "Index Filicum," gives its distribution as N. and N.W. America, California to Sitka, North India, Sikkim, Nepal, Gurwhal, Simla, Kumaon, Japan. There is a var. β. *aleuticum*, Rupr., in the Aleutian Islands.

Pteris.

Pt. aquilina, Linn.—Stipe stout, 1 to 3 feet high, frond ternate, branches bipinnate, pinnules oblong lanceolate, sori continuous under their recurved margins. *Pt. aquilina*, Linn., A. Gray, Moore, &c.—Abundant on Dr Yates's farm in Pittsburg, and elsewhere about Kingston; Waterdown Road, Hamilton, common, Judge Logie; Chippawa and Malden, C.W., P. W. Maclagan, M.D.; Ramsay, Rev. J. K. M'Morine, M.A., Prescott, common, B. Billings, jr.; Belleville, very common on barren ridges, J. Macoun; Grand Island, Lake Superior, R. Bell, jr.; Red Lake River, also between Wild Rice and Red Lake Rivers, and Otter Tail Lake and River, between Snake Hill River and Pembina, &c., J. C. Schultz, M.D.; Black Lead Falls, and Portage to Bark Lake, W. S. M. D'Urban; Gatineau Mills, very common, D. M'Gillivray, M.D.; Lakefield, North Douro, Mrs Traill; New Brunswick, Hook. Fl. Bor. Amer.; L'Orignal, J. Bell, B.A.; London, W. Saunders.

α. vera.—Pinnules pinnatifid (the normal or typical form of Moore), Dr Yates's farm, Kingston.

β. integerrima.—Pinnules entire (a sub-variety), common in Canada and westward. There are various other sub-varieties, differing in size, pubescence, &c.

γ. decipiens.—Frond bipinnate, thin and membranous, lanuginose, pinnules pinnatifidly toothed, or, in small forms, entire, barren; L'Anse à Cabièlle, Gaspé, John Bell, B.A. This is a very remarkable fern, resembling a Lastrea, and in the absence of fructification, it is doubtfully referred to *Pteris aquilina*, yet the venation seems to indicate that it belongs to that species, which is remarkable for its puzzling forms. Being at a loss what to make of this fern, I sent it to Mr D. C. Eaton, M.A., who is justly looked up to by American botanists as our best authority on American ferns, and he likewise failed to recognise it. I hope some visitor to Gaspé will endeavour to obtain it in a fertile state, and thus relieve the doubt.*

[Var. *δ. caudata* appears occasionally in lists. I have as yet no satisfactory evidence of its occurrence in Canada proper. The nearest

* Since the above was written, I have had an opportunity of studying the forms and development of *Pteris aquilina*, and am quite satisfied that the doubtful plant is a state of that species, not old enough to be fertile.

approach to it is a specimen from the Hudson's Bay territories, probably from the Red River District (Governor M'Tavish). In the South it is a very distinct form, of which there are beautiful specimens in Wright's Cuban Plants (No. 872), and is very close to the *Pteris esculenta* of Australia.]

PELLÆA.

P. atropurpurea, Link.—Stipe and rachis almost black, shining, 6 to 12 inches high, frond coriaceous, pinnate, divisions opposite, linear-oblong or somewhat oval. *Pteris atropurpurea*, Linn. *Platyloma atrop.*, J. Sm., Torr. Fl. N. Y., ii. p. 488. *Allosorus atropurpureus*, A. Gray. *Pellæa atropurpurea*, Link., Fée, J. Sm. in Cat., Eaton.—Niagara River, at the Whirlpool, three miles below the Falls. This fern seems to retain its fronds all winter, for I have fertile specimens. in a fine state, collected at the Whirlpool at the end of February 1859 by A. O. Brodie. Dr P. W. Maclagan has also collected it there. It is not common anywhere on the American Continent so far as I can learn. Mr Lowe speaks of it as in cultivation in Britain, "an evergreen frame or greenhouse species, not sufficiently hardy to stand over winter's cold." There must be some other reason for want of success in its cultivation in Britain.

ALLOSORUS.

A. Stelleri, Ruprecht.—Fronds pale-green, thin and papery, 3 to 9 inches long, bipinnate or tripinnate, some of the smaller barren fronds scarcely more than pinnate; pinnæ five or six pairs; lobes of the barren frond, rounded, oval, veiny; of the fertile frond, much narrower, linear-lanceolate, firmer; sori at the tips of the forked veins along the margins, stipe red, whole plant glabrous. A beautiful and delicate fern, growing in the crevices of rocks, rare. *Allosorus Stelleri*, Ledeb. Fl. Rossica. *Allosorus gracilis*, Presl., A. Gray, Torrey Fl. N. Y. ii. p. 487. In a letter from Mr T. Moore (1857), he mentioned to me that he had learned from specimens from Dr Regel, St Petersburg, that "the North American *Allosorus gracilis* was the old *Pteris Stelleri* of Amman, so that it spreads from North America through Siberia to India, whence Dr Hooker has it." *Allosorus minutus*, Turcz. Pl. Exs. *Cheilanthes gracilis*, Klf. *Cryptogramma gracilis*, Torrey. *Pteris Stelleri*, Gmelin. *Pteris minuta*, Turcz. Cat. Pl. Baik. Dah. *Pt. gracilis*, Michaux.—Near Lakefield, North Douro, C.W., on rocks, Mrs Traill; abundant in crevices of limestone rocks, on the rocky banks of the Moira, Belleville, Co. Hastings, J. Macoun; Lake of Three Mountains, W. S. M. D'Urban; Canada to the Saskatchewan, Hook. Fl. Bor. Am.; Dartmouth, Gaspé, John Bell, B.A. This is a northern species, and rare in the United States.

CRYPTOGRAMMA.

C. acrostichoides, R. Br.—"Remarkable for its sporangia extending far down on the oblique veins, so as to form linear lines of fruit." I have not seen the plant. It is referred by Sir William Hooker to *Allosorus crispus* (A. Gr. in Enum. of Dr Parry's Rky. Mtn. Plants). *Cryptogramma acrostichoides*, R. Br., Moore. *Allosorus acrostichoides*, A. Gr.—Isle Royale, Lake Superior. Placed in Dr Hooker's Table as a

Canadian species that does not extend into the United States. It has recently been found on the Rocky Mountains. *Allosorus crispus* is general throughout Europe, and occurs at Sitka, in North-West America. Mr Moore observes that the Eastern (Indian) species, *A. Brunoniana*, is very doubtfully distinct from the European plant.

Struthiopteris.

S. germanica var. *β pennsylvanica.*—Rhizome stout, erect; fronds tufted; sterile ones large pinnate, erect-spreading, deeply pinnatifid; the fertile ones erect, rigid, with revolute contracted divisions, wholly covered on the back by sporangia. A very graceful fern, well suited for cultivation in gardens. *Struthiopteris pennsylvanica*, Willd., Pursh, J. Sm. Cat. *S. germanica*, Hooker, Torrey Fl. N. Y. ii. p. 486, Gray. *Osmunda Struthiopteris*, Linn.; *Onoclea Struthiopteris*, Schkr.; *Onoclea nodulosa*, Schkr., according to Hooker. Torrey refers *O. nodulosa*, Michx., to *Woodwardia angustifolia.*—Frankville, Kitley; Longpoint; Lansdowne; Hardwood Creek; usually found along the margins of creeks, &c.; common in rich, wet woods near Prescott, and abundant around Ottawa, B. Billings, jr.; low rich grounds, Belleville, abundant along Cold Creek, J. Macoun; Re-we-naw Point, Lake Superior, in low ground, at times under water, R. Bell, jr.; Ramsay, Rev. J. K. M'Morine, M.A.; near Lakefield, North Douro, Mrs Traill; field beyond Waterdown, Hamilton, Judge Logie; Osnabruck and Prescott Junction, Rev. E. M. Epstein; near Montreal, W. S. M. D'Urban; Assiniboine River, John C. Schultz, M.D.; Canada, to the Saskatchewan, Hook. Fl. Bor. A.; Pied du Tourmente, M. L'Abbé Provancher. This is the commonest plant in the Bedford Swamps; Gaspé and L'Orignal, J. Bell, B.A.; London, W. Saunders. Found in the western part of New York State, but rare according to Torrey.

Onoclea.

O. sensibilis, Linn.—Rhizome creeping; barren frond broad, leafy, deeply pinnatifid; fertile ones erect, spicate, contracted, doubly pinnate, with small revolute pinnules, enclosing the sporangia, not at all leafy. *Onoclea sensibilis*, Linn., A. Gr., J. Sm., &c. Lowe's Ferns, vol. vi. pl. 1.—In woods along the banks of the Little Cataraqui Creek in great abundance, and in moist swampy places in the woods in various other places about Kingston; west end of Loborough Lake; Becancour, M. L'Abbé Provancher; London, W. Saunders; common in marshy ground at Hamilton, Judge Logie; Lakefield, North Douro, Mrs Traill; St John's, C. E., Niagara and Malden, P. W. Maclagan, M.D.; Belleville, in low marshy places, abundant, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; Amagos Creek, Lake Superior, R. Bell, jr.; Prescott, common, B. Billings, jr.; on the river shore, Gatineau Mills, D. M'Gillivray, M.D.; L'Anse au Cousin, Gaspé and L'Orignal, J. Bell; Nova Scotia. This curious fern has been cultivated in England since 1699; at Kew, since 1793. It is very variable as regards the outline and subdivision of the barren frond.

Var. *β. bipinnata.*—Fronds bipinnate; perhaps not a constant form. Fertile fronds of this variety originated the *O. obtusilobata*, Schkr. Pêche River, and near Cantley, Hull, D. M'Gillivray, M.D.

Asplenium.

A. Trichomanes, Linn.—Frond small, narrow, linear, pinnate; pinnæ roundish-oblong or oval, oblique, almost sessile, crenate: rachis blackish brown, shining, margined; sori distant from the midrib. *Asplenium Trichomanes*, Linn., Moore, Gray, &c., Lowe's Ferns, vol. v. pl. 22. *Asp. melanocaulon*, Willd., Pursh. Fl. Sept. Americ. ii. p. 666. *Asp. anceps*, Lowe.—Inhabits rocky river banks, &c., but is not common in Canada. On rocky banks, at Marble Rock, on the Gananoque River; Namainse, dry ground on the top of a mountain, R. Bell, jr.; rocky woodlands west from Brockville, rare, B. Billings, jr.; Montreal, Jones's Falls and Niagara, P. W. Maclagan, M.D.; Lake Medad, Hamilton, Judge Logie; Pittsburg, near Kingston, John Bell, B.A.; Pied du cap Tourmente, M. L'Abbé Provancher; near Belleville, J. Macoun.

β. delicatulum.—Frond narrower, pinnæ much smaller, thinner, and wider apart than in the normal form. This is a sub-variety, passing by intermediate states into the typical plant, which is the common form of northern Europe. The variety is the prevalent form in Canada, but also occurs farther south in the United States, for I have specimens from Catskill (A. O. Brodie), and is not confined to the American continent, for Professor Caruel, the acute author of "Flora Italiana," sends specimens of a similar form from Florence. There is an *Asp. Trich.* var. *majus* in Cuba (according to Mr Eaton's Enumeration of Wright's Cuban ferns). *A. anceps* is a Madeiran form, not distinguishable, so far as I can see, from common European states of *A. Trichomanes*.

A. viride, Hudson.—Frond small, linear, pinnate; pinnæ roundish-oblong or oval, more or less cuneate at base, slightly stalked, crenate or slightly lobed; rachis bright green; sori approximate to the midrib; in outline of frond and general aspect resembles the preceding species. *A. viride*, Hudson, Flora Anglica, 385; Sm., Bab., Moore, &c. *A. Trichomanes, β ramosum*, Linn.—This beautiful alpine fern was found in Canada for the first time last summer, having been collected in considerable quantity at Gaspé, C.E., by John Bell, B.A., who formed one of a party of the Provincial Geological Survey. It was previously known to occur sparingly in N.W. America, at one spot on the Rocky Mountains, and in Greenland. Mr Bell's discovery of its occurrence in Gaspé is therefore extremely interesting in a geographical point of view. The Gaspé specimens although young, agree perfectly with the typical European form of *A. viride*, of which I have a full series of Scotch examples, as well as others collected in Norway by T. Anderson, M.D. In young specimens the pinnæ are usually large, thin, and more cuneate and lobed than in the mature plant, in which they are roundish-ovate.

A. angustifolium, Michx.—Frond large (1 to 3 feet high), annual, lanceolate, pinnate; pinnæ long, linear-lanceolate, acute; fertile fronds more contracted than the barren ones, "bearing sixty to eighty curved fruit dots on the upper branches of the pinnate forking veins," (Eaton). *A. angustifolium*, Michaux, A. Gray, Eaton, J. Smith, Lowe's Ferns, vol. v. pl. 24.—In Canada this fern appears to be confined to the extreme south-western point of the province;* Malden, P. W. Maclagan,

* Subsequently found in the Belleville district by Mr Macoun.

M.D.; at the Oil Wells, township of Enniskillen, Lady Alexander Russell. For information of the latter station I am indebted to the kindness of Judge Logie of Hamilton. This fern appears to be still rare in cultivation among the fern fanciers of Europe. It was introduced to Britain in 1812 by Mr John Lyon of Dundee.

A. ebeneum, Aiton.—Frond erect, lanco-linear, pinnate; pinnæ numerous, lanceolate (the lower oblong), sessile, slightly auricled at base and finely serrate; rachis blackish-brown, shining. *Asplenium ebeneum*, Aiton, Hortus Kewensis, ed. 2, vol. v. p. 516, Gray, Eaton, J. Smith, Lowe's Ferns, vol. v. pl. 2. *A. polypodioides*, Schkr.—Rocky woods, Brockville, B. Billings, jr.; the only locality in Canada from which I have seen specimens.* Although so rare with us, this species appears to be not uncommon in the United States. Gray speaks of it as "rather common;" I have specimens from Schooley's Mountains, West Point, N. Y., Providence, Philadelphia, &c. Judging from Mr Eaton's indication in Chapman's Flora, it again seems to decrease in the south, so that its present headquarters are in the Northern States.

[*A. marinum*, Linn.—Frond broad and leafy, linear-lanceolate, tapered above, pinnate; pinnæ ovate-oblong or linear, oblique, shortly stalked, rarely pinnatifid, the upper ones confluent, stipe brownish, rachis brown below, green and winged above, sori large, linear, oblique; grows on rocks. *Asplenium marinum*, Linn., Moore, J. Smith, &c. *A. lætum*, Hort.—New Brunswick, E. N. Kendal, in Hook. Fl. Bor. Am. I cannot learn that this fern has been subsequently found in North America, and hope, therefore, that botanists will look for it on the rocky shores of New Brunswick. It usually grows out of the crevices of shore cliffs, and is very limited in its geographical range, growing, according to Moore, only in the western part of Europe, crossing from Spain to Tangiers on the African coast, and being again met with in Madeira, the Azores, and Canary Isles.]

A. thelypteroides, Michaux.—Fronds large oblong-ovate, pinnate; pinnæ lanceolate, acuminate, from a broad sessile base, and deeply pinnatifid, the lobes oblong, minutely toothed. *Asplenium thelypteroides* Michaux, Pursh, Bigelow, Torrey, Beck, Darlington, Gray, Eaton. *Diplazium thelypteroides*, Presl, J. Sm.—In rich woods, De Salaberry, west line, W. S. M. D'Urban; Mirwin's woods, &c., Prescott, B. Billings, jr.; Beloeil Mountain, P. W. Maclagan, M.D.; moist woods near the Hop Garden, Belleville, rare, J. Macoun (a deeply serrated, leafy form); Ramsay, J. K. M'Morine, M.A.; St Joachim, M. L'Abbé Provancher; London, W. Saunders. Not a common fern in Canada; perhaps more plentiful in the United States. I have a fine series of specimens from Schooley's Mountains (A. O. Brodie), and others from Providence.

β. serratum.—Lobes of the pinnæ ovate-oblong, approximate, strongly and incisely serrate. This may be regarded as a sub-variety.—Belleville, J. Macoun.

[*A. montanum*, Willd., which extends along the Alleghanies, has not yet been found in Canada, but may possibly occur. It grows on cliffs.]

[*A. Ruta-muraria*, Linn.—The wall-rue, a small species, which grows in the crevices of limestone cliffs in the Northern States, and is common

* Subsequently found near Belleville by Mr Macoun.

on stone walls and old buildings in Britain, is to be looked for in Canada.]

Athyrium.

A. Filix-fœmina, R. Br.—Frond ample (1–3 feet long), broadly oblong-lanceolate, bipinnate; pinnæ also lanceolate; pinnules ovate-lanceolate or oblong, incisely toothed. Grows in large tufts, the fronds delicate, of a bright green hue. Lady Fern of the poets. *Athyrium Filix-fœmina*, R. Br., Spreng., Roth., Hook., Moore, &c. *Aspidium Filix-fœmina*, Swartz, Pursh, Beck. *Aspidium asplenioides*, Swartz, Willd., Pursh. *Asplenium Athyrium*, Schkr. *Asplenium Michauxii*, Spreng. *Asplenium Filix-fœmina*, A. Gray Man., p. 595. *Nephrodium asplenioides* and *Filix-fœmina*, Michx. *Asplenium angustum*, Willd., Pursh.—Common in the woods, as near Kingston, Toronto, Trenton, &c.; Pêche River, Ottawa, Dr M'Gillivray; Temiscouata, Chippawa and Malden, P. W. Maclagan, M.D.; Belleville, moist woods, very common, several varieties, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; mouth of the Awaganissis Brook, Gulf of St Lawrence, C.E., and Schibwah River, Lake Superior, R. Bell, jr.; Cemetery grounds, Hamilton, and on Princes Island, Judge Logie; Hamilton's Farm and base of Silver Mt, W. S. M. D'Urban; Mountain Fall, H. B. T., Governor M'Tavish; Snake Hill River, John C. Schültz, M.D.; L'Anse à la Barbe, Gaspé and L'Orignal, John Bell, B.A.; St Tite, M. L'Abbé Provancher; London, W. Saunders.

β. angustum. — Frond narrow, linear-lanceolate; pinnæ rather crowded; pinnules not pinnatifid, but incisely toothed, with recurved margins; sori short, curved (*Aspidium angustum*, Willd.?)—Farmersville; Delta; Belleville, J. Macoun.

γ. rhæticum.—Frond rather small, firm, narrowly lanceolate in outline; pinnæ more or less distant, and narrowly lanceolate; pinnules incisely toothed or deeply pinnatifid, linear, or more frequently lanceolate-acute, and acquiring a linear aspect from the reflection of the lobes, often crowded with confluent sori.—Dr Yates's farm, on the banks of the St Lawrence, near Kingston; near Montreal, Rev. E. M. Epstein, M.D.; near Lakefield, North Douro, Mrs Traill.

δ. rigidum.—Frond small, rigid; pinnules approximate, connected at the base by a broad decurrent membrane, sori confined to the lower part of each pinnule.—Lakefield, North Douro, Mrs Traill.

There are other forms of this species, dependent in many cases, no doubt, upon situation; some with thin veiny fronds of great size, bearing few scattered sori. One form, very like the British var. *molle*, was gathered at Belleville by Mr Macoun. I know no fern more variable than this. Our Canadian forms require careful examination.

Woodwardia.

W. virginica, Willd.—Frond pinnate; pinnæ lanceolate, pinnatifid; sori arranged in line on either side of the midribs of pinnæ and pinnules. *Woodwardia virginica*, Willd.; A. Gray Man. p. 593. *(Doodia*, R. Br.)—Millgrove Marsh, C.W., Judge Logie; sphagnous swamp near Heck's Mills, ten miles from Prescott, Augusta, C.W., B. Billings, jr.; Pelham, C.W., P. W. Maclagan, M.D.; Belleville, J. Macoun.

SCOLOPENDRIUM.

S. vulgare, Smith.—Fronds (in tufts) strap-shaped, with a cordate base, undivided, margin entire, stipe scaly. *Scolopendrium vulgare*, J. E. Smith, Bab , J. Sm., Moore, &c. *S. officinarum*, Swartz, Schkr., Gray Man., p. 593; Torr. Fl. N. Y. ii. p. 490. *S. Phyllitis*, Roth. *S. officinale*, DC. *S. Lingua*, Cavanilles. *Asplenium Scolopendrium*, Linn. Sp. Plantarum, &c. *A. elongatum*, Salisb. *Blechnum linguifolium*, Stokes. *Phyllitis Scolopendrium*, Newman.—Owen Sound, Georgian Bay, Lake Huron, on soft springy ground, amongst large stones, growing in tufts, abundant, 1861, Robert Bell, junior, C.E. This interesting addition to our list of Canadian ferns has been collected in the same place by the Rev. Prof. William Hincks, F.L.S. Mr Bell's specimens agree, in every respect, with the typical European form of the species, which is exceedingly variable. Only one station was previously known for this fern in all North America, viz., limestone rocks along Chittenango Creek, near the Falls, respecting which Professor Torrey observed :—" This fern is undoubtedly indigenous in the locality here given, which is the only place where it has hitherto been found in North America." It was first detected by Pursh, who found it in shady woods, among loose rocks in the western parts of New York, near Onondago, on the plantations of J. Geddis, Esq. This species (he said) I have seen in no other place but that here mentioned, neither have I had any information of its having been found in any other part of North America. (*Pursh.*) Nuttall states that he found it in the western part of the state, without giving the locality; but according to Dr Pickering, the specimens of Mr Nuttall, in the herbarium of the Academy of Sciences in Philadelphia, are marked, " Near Canandaigua, at Geddis's farm, in a shady wood, with *Taxus canadensis*," Torrey Fl. N. Y. ii. p. 490. This fern occurs throughout Europe, and also in Northern Asia. Mr Moore considers the Mexican *S. Lindeni* as a mere variety of this species. In Europe there are many remarkable varieties, of which Mr Moore has figured and described more than fifty that occur in Britain. The great beauty and remarkable character of many of these render them very suitable for cultivation. None of the abnormal forms have as yet been found in America, probably merely because they have not been looked for.

CAMPTOSORUS.

C. rhizophyllus, Presl.—Frond lanceolate, broad and hastate, or cordate at base, attenuated towards the tip, which strikes root and gives rise to a new plant; hence this fern is called the Walking Leaf; fronds evergreen. *Camptosorus rhizophyllus*, Link, Presl, A. Gray, Eaton, Hooker. *Asplenium rhizophyllum*, Linn. in part (Linnæus's name included *Fadyenia prolifera*, a totally different plant), Michaux, Pursh Fl. Am. Sept. ii. p. 666, Bigelow, Torrey, Beck, Darlington, Lowe's Ferns, vol. v. pl. 14 *a*. *Antigramma rhizophylla*, J. Sm., Torrey Fl. N. Y. ii. p. 494. *Camptosorus rumicifolius*, Link.—On the flat perpendicular face of a rock in the woods, on the Spike's Corners side of the mills at High Falls, township of Portland, C.W., July 1862. In a rocky wood, a mile north-west from the Oxford station of

the Ottawa and Prescott Railway, upon a rock slightly covered with mould, B. Billings, jr.; mountain side west from Hamilton, also at Ancaster and at Lake Medad, Judge Logie; Wolfe Island, E. J. Fox; not rare about Owen Sound, Rev. Prof. W. Hincks, F.L.S.; Montreal Mountain, M. L'Abbé Provancher; rather northern in its range in North America, but not common anywhere in Canada. This curious fern has been long in cultivation in the botanic gardens of Europe.

LASTREA.

L. dilatata, Presl.—Fronds spreading, broadly lanceolate, rather pale but vivid green, bipinnate; the pinnules pinnate or pinnatifid with pointed lobes; on the lower pinnæ, the posterior pinnules are longer than the anterior ones; stipe with rather distant pale unicolorous scales; sori small. This description refers only to the commonest form in Canada. It is a very variable species *Aspidium spinulosum*, Gray. —Abundant in the woods about Kingston, as Collins's Bay, &c., Smith's Falls, Odessa, woods near the Falls of Niagara, Hinchinbrook, Gananoque Lakes, Farmersville, Hardwood Creek, Delta, Upper Rideau Lake, Newboro-on-the-Rideau, Longpoint; Mouth of the Awaganissis Brook, Gulf of St Lawrence, Goulais River, also Grand Island, and at Ke-wenaw Point, Lake Superior, R. Bell, jr.; Ramsay, Rev. J. K. M'Morine, M.A.; Prescott, very common, B. Billings, jr.; St John's, St Valentine, and Beloeil, P. W. Maclagan, M.D.; Belleville, very common, J. Macoun; St Joy Woods, W. S. M. D'Urban; Daniel's Harbour, Newfoundland, James Richardson (a peculiar form); Pêche River, Chelsea and Cantley, Hull, D. M'Gillivray, M.D. Of varieties referable to var. *Boottii*, Gray, var. *dumetorum*, Gray, or others, differing from the common (which, however, is perhaps not the typical) form, I have seen specimens from, or obtained information of their having been collected in, the following localities:—Malden, Brighton, Point Rich, Newfoundland, Hamilton's Farm, Murray, Hamilton, &c. These varieties still require careful study, with a view to their identification with European forms, which are now well understood.

β. tanacetifolia.—Frond large and very broad, triangular, tripinnate, with the pinnules pinnatifid or deeply incised, lobed. *P. tanacetifolium*, DC. ?—Pointe des Morts, Gaspé, John Bell, B.A. Mr Bell's specimen seems to agree well with Mr Moore's description of var. *tanacetifolia*. The typical *L. dilatata*, with dark-centred scales, so common in Scotland, I have not yet seen growing in the Canadian woods; but a fragment, the upper portion of a frond, from Point Rich, Newfoundland, James Richardson, looks like it.

L. marginalis, J. Smith.—Frond ovate-oblong, a foot, more or less, in length, bipinnate, pale green, somewhat coriaceous, lasting the winter; pinnæ linear-lanceolate, broad at base; pinnules oblong, very obtuse, obsoletely incised; sori marginal; stipe of a pale cinnamon colour when old, with large thin pale scales profuse below. *L. marginalis*, J. Sm., *Aspidium marginale*, Swartz, Pursh, Bigelow, Beck, Darlington, Gray, Eaton, Lowe's Ferns, vol. vi., pl. 6 (a bad figure), Torrey Fl. N. Y. ii. p. 495. *Polypodium marginale*, Linn. *Nephrodium marginale*, Michaux.—This species is as common in the Canadian woods as *Lastrea Filix-mas* is in those of Britain; woods around Kingston, abundant;

near Odessa; Newboro-on-the Rideau; along the course of the Gananoque River and lakes, in various places; very fine at Marble Rock; Farmersville; Hardwood Creek; Valley of the Trent, found on the great boulder, &c.; on Judge Malloch's farm and elsewhere about Brockville; on limestone rocks above the Rapids at Shaw's Mill, Lakefield, North Douro, Mrs Traill; Sulphur Spring, Hamilton, Judge Logie; Cedar Island, A. T. Drummond, jr., B.A.; Smith's Falls, and Chippawa, P. W. Maclagan, M.D.; Ramsay, Rev. J. K. M'Morine, M.A.; Prescott, common, B. Billings, jr.; Belleville, in rich low moist woods, common, J. Macoun; above Blacklead Falls, W. S. M. D'Urban; Gatineau Mills, D. M'Gillivray, M.D.; Cap Tourmente, M. L'Abbé Provancher; Harrington, J. Bell, B.A.; London, W. Saunders. This is exclusively an American fern. It varies in size and appearance; in some specimens the pinnæ are wide apart, their divisions small and narrow; in others, the pinnæ overlap each other, and their divisions are broad and leafy, also overlapping, and in such forms they are usually toothed into rounded lobes. Mr Macoun sends a form from Belleville, more deeply serrate than usual.

β. *Traillæ.*—Fronds very large (3½ feet long), bipinnate, all the pinnules pinnatifid.—Lakefield, North Douro, Mrs Traill. This is a very handsome variety, and would form an attractive plant in cultivation. It has the same relation to the type of *L. marginalis* which *incisa* (*erosa*) has to typical *Filix-mas.*

Lastrea Filix-mas is erroneously referred to in some American works on Materia Medica as a common North American and Canadian fern. It has recently, however, been found on the Rocky Mountains by Dr Parry. Professor Gray says that Dr Parry's specimens are apparently identical with the European plant. Nothing like it occurs in Canada, so far as I can ascertain. Varieties of *L. marginalis* have been sent to me under the name of *Filix-mas.*

L. cristata, Presl.—Fronds erect, rigid, linear-oblong in outline, vivid green, pinnate or slightly bipinnate; pinnæ triangular-lanceolate; pinnules large, oblong, approximate, decurrent; sori large, in a single series on each side of, and near to, the vein; stipe with few pale scales. *Lastrea cristata*, Presl, Moore, &c. *Polypodium cristatum*, Linn. *Aspidium cristatum*, Swartz, Willd., Pursh, E. B., Beck, Torrey Fl. N. Y., ii. p. 496, Gray. *Aspidium cristatum*, β. *lancastriense*, Torrey; *A. lancastriense*, Spreng., Bigelow, Beck, Darlington, Hooker.—Woods around Kingston; near the Pêche River, Gatineau, a tributary of the Ottawa, D. M'Gillivray, M.D.; Three Rivers, St John's, and Chippawa, P. W. Maclagan, M.D.; Sproule's Swamp, east from Belleville (a cedar swamp), not common, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; Prescott, common, B. Billings, jr.; Lake of Three Mountains, W. S. M. D'Urban; Silver Brook, Gaspé, John Bell, B.A.; St Ferreol, M. L'Abbé Provancher; L'Orignal, J. Bell; London, W. Saunders.

L. Goldieana, J. Smith.—Frond very large (3 or 4 feet or more in length), dark green, bipinnate; pinnæ 6 to 8 inches long, narrow, linear-lanceolate, not much attenuated towards the tips; pinnules (12–20 pairs), linear-oblong, approximate, uniformly curved forwards, scythe-shaped, sometimes with an extra lobe at base; sori small, near the midrib; stipe with pale shaggy scales above and larger dark-centred ones below; our largest Canadian fern, usually barren. *Lastrea Goldieana*,

J. Smith. *Aspidium Goldieanum*, Hooker, Edin. New Phil. Jour. vi. p. 333, and Fl. Bor. Am., ii. p. 260, Gray. *Nephrodium Goldieanum*, Hook. and Grev. *Aspidium Filix-mas*, Pursh, not of Willd., &c.—Farmersville, in woods near the village, abundant and very fine, forming immense tufts; near Hamilton's Farm and De Salaberry, town line, W. S. M. D'Urban; Beloeil Mountain, Montreal and Malden, P. W. Maclagan, M.D.; Belleville Woods, near Castleton; woods below Heely's Falls, west side, and in Simon Terrill's Woods, Brighton, J. Macoun. Augusta, Robert Jardine, B.A.; about Montreal, Mr Goldie in Hook. Fl. Bor. Am. London, W. Saunders. This fine fern was appropriately named by Sir William Hooker in honour of its discoverer, a successful investigator of Canadian botany, now resident at Paris, C.W. The species belongs exclusively to the American Continent. In Canada we have two sub-varieties:—

α. serrata, in which the divisions of the pinnæ are coarsely serrate. Montreal.

β. integerrima, in which the divisions of the pinnæ are almost or quite entire. Farmersville.

L. fragrans, Moore.—Frond 8 to 12 inches long, coriaceous, bipinnate, pinnæ triangular, of few (4 or 5 pairs) of pinnules, which are crowded and covered beneath by the large rusty membranous indusia, which conceal the sori. Rachis with profuse, large, palish scales, especially near the base. *Aspidium fragrans*, Swartz, A. Gray.—Rocks, Penokee Iron Ridge, Lake Superior, Mr Lapham, and north-west—Professor Woods, in Class-Book; shaded trap rocks, Falls of the St Croix, Wisconsin, Dr Parry, and high northward, Gray's Manual. I have not yet seen Canadian specimens of this species, which is quite a northern fern, stretching along the northern shores of the Pacific to the Russian Arctic dominions. I have specimens from Repulse Bay, collected by Captain Rae's party while wintering there in 1855. This plant does not appear to be in cultivation in any European garden.

L. Thelypteris, Presl.—Frond erect, lanceolate, mostly broad at base, and narrowed upwards, thin, and herbaceous, or slightly coriaceous, glabrous or downy, pinnate; pinnæ linear, rather distant, deeply pinnatifid; pinnules with revolute margins, veins forked, sori near their middle, becoming confluent. Stipe as long as, or longer than, the frond, and naked. *Lastrea Thelypteris*, Presl, Moore, J. Sm. *Aspidium Thelypteris*, Swartz, E. B. Willd., Pursh, Bigelow, Beck, Darlington, Torrey Fl. N. Y. ii. p. 496, A. Gray, Man. *Polypodium Thelypteris*, Linn. *Dryopteris Thelypteris*, A. Gr.—Swamps in the woods, Townships of Hinchinbrook, Portland, Ernestown, &c.; Millgrove Marsh, Hamilton, Judge Logie; Gatineau Mills on the Ottawa, D. M'Gillivray, M.D.; Prescott, common, B. Billing, jr.; Temiscouata, Thorold and Malden, P. W. Maclagan, M.D.; Belleville, very common in swamps, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; portage to Bark Lake, and on lumber road through the woods east from Hamilton's Farm, W. S. M. D'Urban; Montreal, Drs Maclagan and Epstein; Hudson's Bay Territories near Red River Settlement, Governor M'Tavish; St Joachim, M. L'Abbé Provancher; L'Orignal, J. Bell, B.A.; London, W. Saunders. In the State of New York this species is common in swamps and wet thickets (Torrey). I have it from West Point, N. Y.

In the south, Eaton indicates Florida and northward. Very seldom found with fructification (Pursh). Fertile specimens are not rare with us. The forked veins of the pinnules distinguish this species from the next. In the Canadian plant the outline of the frond is a little different from Scotch and Irish specimens, being less narrowed at base. There are three forms of this species in Canada. The first (α) seems to be the plant of Gray's Manual, the second (β) is more like the *L. Thelypteris* of Europe, and the third (γ) is intermediate between this species and the next.

α. *pubescens.*—Frond somewhat coriaceous, densely pubescent or downy throughout. Odessa, Hudson's Bay, &c.

β. *glabra.*—Frond thin, herbaceous, glabrous. Montreal, Chelsea, Hinchinbrook, &c.

γ. *intermedia.*—Frond narrowed below, glabrous; stipe slightly elongated (veins forked). Gaspé, J. Bell, B.A.

L. Nov-Eboracensis.—Frond lanceolate, narrow at the base, thin and herbaceous, pinnate; pinnæ linear or linear-lanceolate, more or less approximate, deeply pinnatifid; pinnules oblong, usually flat; veins simple (not forked); sori never confluent; stipe short, rachis, &c. downy, pinnules more or less distinctly ciliate. *Lastrea Noveboracensis*, Presl; *Polypodium Noveboracense*, Linn., Schk. *Aspidium thelypteroides*, Swartz. *Aspidium Noveboracense*, Willd., A. Gray, Eaton—Pittsburg near Kingston; Lakefield, North Douro, Mrs Traill; Mountain side, Hamilton, Judge Logie; Prescott, common, B. Billings, jr.; Mount Johnson, Montreal, and Beloeil, P. W. Maclagan, M.D.; Ramsay, Rev. J. K. M'Morine, M.A.; near Chelsea, D. M'Gillivray, M.D.; London, but not common, W. Saunders; L'Orignal, J. Bell. This fern belongs exclusively to the American Continent. It seems to be more abundant and more distinct in the United States than with us. In *Flora Boreali-Americana*, Sir William Hooker observed—"The *Aspidium Noveboracense* is quite identical with *A. Thelypteris.*" In the recently published volume of *Species Filicum* (which at present I can only quote at second hand), doubts are still expressed as to its being a species really distinct from *L. Thelypteris.* Mr Eaton and other American pteridologists think it quite distinct. Its most obvious characters are—(1.) The tapering form of the lower part of the frond (although there is also a form of *L. Thelypteris* having this peculiarity; (2.) sori few, mostly near the base of the pinnules, and not confluent, not overlapped by a recurved margin; (3.) veins of the pinnules simple, not forked. The outline of the frond must not be depended upon, as the Scotch and Irish *L. Thelypteris* is narrowed at the base like *L. Nov-Eboracensis.* This species is allied to *L. montana*, Moore (*Oreopteris*, Bory).

Polystichum.

F *P. angulare, β. Braunii.*—Frond soft, herbaceous, lanceolate, bipinnate; pinnules stalked, serrate; the small teeth tipped by soft bristles; stipe and rachis scaly throughout In the Canadian plant the scales of the rachis are larger than in the typical *P. angulare* of England, from which it may be specifically distinct. *Aspidium Braunii*, Spenner. *Aspidium aculeatum* var. *Braunii*, A. Gray, Man. Bot., p. 599, *A.*

aculeatum, Provancher; Harrington, Cap Bon Ami and Dartmouth, N. fork, Gaspé, John Bell, B.A.; base of Silver Mountain, W. S. M. D'Urban.

P. Lonchitis, Roth.—Frond rigid and shining, linear-lanceolate, simply pinnate; pinnæ scythe-shaped, auricled, spinose. *Polystichum Lonchitis*, Roth, Moore, J. Sm., &c. *Polypodium Lonchitis*, Linn. *Aspidium Lonchitis*, Swartz, Schk.—Limestone rocks, Owen Sound, C.W., 1859, Rev. Professor William Hincks, F.L.S. Professor Hincks has kindly furnished me with specimens from the above locality. Woods, southern shore of Lake Superior and north-westward, Professor Asa Gray, in Man. Bot., N.S.; British America, Professor Woods in Class-Book. It will be observed that Professor Hincks's station is the only definite Canadian one with which we are acquainted. Mr T. Drummond found this fern on the Rocky Mountains many years ago.

P. acrostichoides, Schott.—Frond pale green, shining, long and narrow, linear-lanceolate, simply pinnate; pinnæ long and narrow, linear-lanceolate, shortly stalked, auricled anteriorly at the base, more or less distinctly serrate, with hair-tipped teeth; fertile (upper) pinnæ slightly contracted, covered beneath by the large confluent sori; stipe profusely chaffy, with pale scales. *Polystichum acrostichoides*, Schott, J. Sm. *Aspidium acrostichoides*, Swartz, A. Gray, Eaton. *Aspid. auriculatum*, Schk. *Nephrodium acrostichoides*, Michx.—Abundant in the woods a few miles west from Kingston; also not rare in the woods of the Midland District of Canada generally; Upper Rideau Lake; woods around Toronto, Rev. Dr Barclay; Stanfold, M. L'Abbé Provancher; L'Orignal, J. Bell; London, W. Saunders: Sulphur Spring, Hamilton, Judge Logie; Prescott, common, B. Billings, jr.; Nicolet and St Valentine, C.E., and Chippawa, C.W., P. W. Maclagan, M.D.; Belleville, very common in rocky woods, as in Hop Garden, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; hills and woods, portage to Bark Lake, W. S. M. D'Urban; Gilmour's Farm, Chelsea, D. M'Gillivray, M.D.; Osnabruck and Prescott Junction, Rev. E. M. Epstein. This species is exclusively American.

[β. *incisum;* pinnæ strongly serrate or incised into lobes. *Aspidium Schweinitzii*, Beck. This form, which I have from Schooley's Mountains, &c. (A. O. Brodie), will no doubt be found in Canada.]

Cystopteris.

C. fragilis, Bernhardi.—Fronds delicate, green, lanceolate in outline, glabrous, bipinnate; pinnæ and pinnules ovate-lanceolate or oblong; the latter obtuse, incisely toothed, thin and veiny; sori large; stipe dark purple at the base. *Cystopteris fragilis*, Bernhardi, Hook., Bab., Moore, Newm., A. Gray. *Polypodium fragile*, Linn. *Cystopteris orientalis*, Desvaux. *Polypod. viridulum*, Desv. *Athyrium fragile*, Sadler. *Cyathea fragilis*, Sm. *C. cynapifolia* and *C. anthriscifolia*, Roth. *Cystea fragilis*, Sm. *Cyclopteris fragilis*, S. F. Gray.—Rocky woods and cliffs about Kingston, in various places, but not abundant; Farmersville; Mountain side, Hamilton, on moist rocks, Judge Logie; rocks by the bay shore, L'Anse au Cousin, and Dartmouth River, Gaspé, John Bell, B.A.; Mirwin's woods, Prescott, common, B. Billings, jr.; Montreal and Jones's Falls, P. W. Maclagan, M.D.; rocky banks of

the Moira, rather rare, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; camp at base of Silver Mount, on rocks, also River Rouge, abundant, De Salaberry, west line, and at Black Lead Falls, W. S. M. D'Urban; St Joachim, M. L'Abbé Provancher; Grenville, C. E., John Bell, B.A.; London, W. Saunders. In Dr Hooker's valuable Table of Arctic Distribution this plant is indicated as a Canadian species that does not enter the United States, which I presume arises from a misprint, as the species is not uncommon in the Northern States, and extends south to the Mountains of Carolina. The delicate *C. tenuis* is the form known in the south, but in Canada we have the stout typical European form of *C. fragilis.*

β. angustata.—Pinnules incised, with longish and spreading teeth. *Cyst. frag.* var. *cynapifolia*, J. Lowe.—Gaspé, John Bell, B.A. Specimens referable to this form were likewise gathered at Lake of Three Mountains by Mr D'Urban. Mr Bell's specimens agree perfectly with English specimens from Dr John Lowe (*C. f. cynapifolia*). Italian specimens from Professor Caruel of Pisa, labelled "*Cyst. fragilis,*" belong to this variety. Mr Bell has a fertile frond from Gaspé with very broad veiny pinnæ, deeply incised, but not pinnate.

C. bulbifera, Bernhardi.—Frond thin, green, lanceolate or linear-lanceolate, bipinnate, bulbiferous towards the apex on the under surface; pinnæ oblong-lanceolate, narrowed at the tips; pinnules oblong-obtuse, incisely toothed; sori small, not very numerous; indusium short. Very variable in the size and form of the frond. *C. bulbifera*, Bernhardi, A. Gray, J. Sm. *Aspidium bulbiferum*, Swartz, Schk., Pursh. *Aspidium atomarium*, Muhl.—Moist swampy woods about Kingston, as Collins's Bay, Kingston Mills, &c.; abundant on Judge Malloch's farm, a mile west from Brockville; Petit Portage, &c., Gaspé, John Bell, B.A.; Wolfe Island, A. T. Drummond, B.A.; Mirwin's woods, Prescott, common, B. Billings, jr. (short form); Beloeil Mountain, P. W. Maclagan, M.D.; rocky banks of the Moira, Belleville, and in cedar swamps and wet woods, very common, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; Mountain side, Hamilton, common, Judge Logie; Black Lead Falls, on limestone rock, W. S. M. D'Urban; Pied du cap Tourmente, M. L'Abbé Provancher; Grenville, C. E., J. Bell; London, W. Saunders. There are two distinct forms or varieties of this species.

α. horizontalis.—Frond triangular-lanceolate, broad at base, not more than three or four times longer than broad; pinnæ horizontal. Niagara Falls, within the spray, Collins's Bay, &c.

β. flagelliformis.—Frond linear, attenuated upwards, very long and narrow, six or seven times longer than broad; pinnæ less horizontal. Frankville, Montreal, Gaspé, &c.

DENNSTÆDTIA.

D. punctilobula, Moore.—Frond broadly lanceolate, pale green, thin, with a stout rachis, bipinnate; the pinnules pinnatifid; sori minute, usually one on the anterior basal tooth of each lobe of the pinnule, which is reflexed over the sorus; the proper indusium is pale, cup-shaped, opening at top. Rhizome slender, creeping through the soil; whole plant glandular-downy. *Dennstædtia* (Bernhardi, 1800) *punctilobula*, Moore, Index Filicum, p. xcvii. *Dicksonia punctilobula*, Hooker, A. Gray, J. Sm. *D. pilosiuscula*, Willd, Hook. Fl. Bor. Amer.

Nephrodium punctilobulum, Michx. *Aspidium punctilobulum*, Swartz. *Patania*, Presl. *Dicksonia pubescens*, Schkr. *Sitolobium pilosiusculum*, Desv., J. Sm. Gen. Fil.—Pittsburg near Kingston, John Bell, B.A.; River Rouge, W. S. M. D'Urban; Montreal, P. W. Maclagan, M.D.; Prescott, on Dr Jessup's moist pasture land, B. Billings, jr.; New Brunswick, E. N. Kendal, in Hook. Fl. Bor. Amer.; Ramsay, Rev. J. K. M'Morine. Mr Eaton has mentioned to me that the drying fronds have the odour of new hay.

Woodsia.

W. Ilvensis, R. Br.—Frond lanceolate, usually 4 or 5 inches long, bipinnate, or nearly so, pinnæ approximate, pinnules oblong, obtuse, stipe (red), rachis, and whole lower surface of the frond clothed with chaffy scales, which are rusty at maturity. Sori usually confluent around the margins of the pinnules. First observed in the Isle of Elba (Ilva), hence named, after Dalechamp, *Acrostichum Ilvense*, by Linnæus, whose Phœnix was very wroth thereat; see English Flora, vol. iv. p. 323. *Woodsia Ilvensis*, R. Br., Hook., Moore, J. Sm., Gray, &c. *Nephrodium lanosum*, Michx.—Abundant on the ridge of Laurentian rocks at Kingston Mills; Rocks west from Brockville and at Chelsea, B. Billings, jr.; Mount Johnson and Beloeil Mountain, P. W. Maclagan, M.D.; mountain gneiss rocks, opposite Rouge River, W. S. M. D'Urban. I have likewise specimens from the Hudson's Bay territories (Governor M'Tavish), but without special locality. On rocks, Canada, Pursh; Canada to Hudson's Bay, Hook. Fl. B. A.; Pied du cap Tourmente, M. L'Abbé Provancher. I think our plant must be much larger and more scaly than the European one. A tuft which I have from Catskill Mountains (A. O. Brodie) has richly fruited fronds a foot long and 2 inches wide. (I find that large American forms of this species have been mistaken for *W. obtusa*. The involucre, which is large and *not* split into hairs in the latter species, serves readily to distinguish it.) Much of the Ilvensis in cultivation in Europe is probably the American form.

β. gracilis.—Frond more slender, more hairy and less scaly than the type; pinnæ rather distant, deeply pinnatifid, or partially pinnate. Dartmouth River, Gaspé, John Bell, B.A. In technical characters, this form agrees better with *W. alpina* (*hyperborea*), but it has quite a different aspect.

W. alpina, S. F. Gray.—Frond small (from 1 to 2 or 3 inches long), broadly linear, pinnate, somewhat hairy without distinct scales; pinnæ ovate, somewhat triangular, obtuse, pinnatifidly divided into roundish lobes. *Woodsia alpina*, S. F. Gray, Brit. Pl., Moore. *Woodsia hyperborea*, R. Br. in Linn. Trans., vol. xi.; Pursh. Fl. Am. Sept. ii. p. 660.—In the clefts of rocks, Canada, Pursh; Canada to the Saskatchewan, Hooker. Noticed in Dr Hooker's Table of Arctic Plants as a Canadian species that does not extend into the American States.

W. glabella, R. Br.—Frond a few (2–4) inches long, linear, bright-green and glabrous on both sides, simply pinnate; the pinnæ short, rounded or rhombic, cut into rounded or wedged lobes. Stipe with a few scales at the base only. *Woodsia glabella*, R. Br., Hook. Fl. Boreali Americana, tab. 237; Gray. Canada, Professor Woods in Cl. Bk. Sir W. Hooker, in the Fl. B. Amer., gave Great Bear Lake as the only

station then known for *W. glabella.* Mr D. C. Eaton has kindly furnished me with specimens from Willoughby Lake, Vermont (Goodale leg.), and Professor Gray notices its occurrence on rocks at Little Falls, New York (Vasey), and " high northward."

β. Belli.—Frond larger (6–7 inches long) ; pinnæ more elongated, pinnatifidly incised into rounded lobes (bright green, glabrous). Gaspé, on the Dartmouth River, twenty miles from its mouth, John Bell, B.A.

W. obtusa, Torrey.—Frond nearly a foot long, linear-lanceolate, glandulose, bipinnate; pinnules slightly decurrent, oblong, obtuse, crenate, or somewhat pinnatifid; indusium large, enveloping the sorus, torn into a few marginal lobes; stipe with few scattered, pale, chaffy scales. *Woodsia obtusa,* Torrey, A. Gray, J. Sm. *Aspidium obtusum,* Willd. *Physematium obtusum,* Hook. Fl. Bor. Am. *Woodsia Perriniana,* Hook. and Grev. Ic. Fil. *Polypodium obtusum,* Swartz.—An impression prevails that this plant, which is said to be common in the Northern States, especially towards the west, grows also in Canada. Mr D. C. Eaton, in the kindest manner, cut out of his own herbarium a specimen for me, from near High Bridge, New York city, in an excellent state for examination, which has enabled me to understand the species and to ascertain that we have as yet no satisfactory evidence of its occurrence in Canada. Large forms of *W. Ilvensis* have in some cases passed for it. (I introduce this notice of the plant with a view to promote farther inquiry.)

Osmunda.

O. regalis β. spectabilis.—Fronds erect, pale-green, glabrous. bipinnate; pinnules oblong-lanceolate, oblique, shortly stalked, very slightly dilated at the base, nearly entire; fertile pinnules forming a racemose panicle at the summit of the frond. *Osmunda spectabilis,* Willd., J. Smith. Farmersville; Hardwood Creek, Hinchinbrook, and other places in rear of Kingston, usually in thickety swamps, by corduroy roads, &c.; Millgrove Marsh, Hamilton, Judge Logie; Ramsay, Rev. J. K. M'Morine, M.A.; woods near the Hop Garden, Belleville, not common, J. Macoun; Prescott, common, B. Billings, jr.; around Metis Lake, &c.; opposite Gros Cap; also Sou-sou-wa-ga-mi Creek and Schibwah River, R. Bell, jr.; near Montreal, Rev. E. M. Epstein and W. S. M. D'Urban; mountain, Bonne Bay, Newfoundland, on rocks 1000 feet above the sea, James Richardson (a small form); Welland, J. A. Kemp, M.D.; Osnabruck and Prescott Junction, Rev. E. M. Epstein; Nicolet, Wolfe Island and Navy Island, P. W. Maclagan, M.D.; Lake St Charles, M. L'Abbé Provancher; Caledonia Springs and L'Orignal, J. Bell; Portland, Thos. R. Dupuis, M.D.; Bedford; London, W. Saunders. The fronds of our plant are a little more drawn out than those of the European one; the pinnules are often distinctly stalked, and the overlapping auricles either altogether absent or only slightly developed. This is *O. spectabilis,* Willd.; *O. regalis, β.* Linn. Sp. Pl. Some botanists distinguish two American forms, one agreeing with the typical *regalis* of Europe; but it is difficult to do so. The typical *O. regalis* is a larger, more robust, and more leafy plant, with more widely spreading or divergent pinnæ, and more leafy auricled sessile pinnules, more or less pinnatifid at the base; in our Canadian plant they are quite entire.

The divisions of the fertile portion of the pinnæ are also more widely divergent in *a regalis*. The frond, moreover, is of a darker colour.

O. cinnamomea, Linn.—Sterile and fertile fronds distinct, the former ample, broadly lanceolate, pinnate; the pinnæ rather deeply pinnatifid; lobes regular, entire; fertile frond contracted, erect, in the centre of the tuft of sterile fronds, and not at all foliaceous. Sporangia ferruginous. Fertile frond decaying early in the summer. *Osmunda cinnamomea*, Linn, Gray, J. Sm. *O. Claytoniana*, Conrad, not of Linn.—Fairfield farm and elsewhere about Kingston, not uncommon; Millgrove Marsh, Hamilton, Judge Logie; Sandwich and Montreal, P. W. Maclagan, M.D.; opposite Gros Cap; also Two Heart River, Lake Superior, R. Bell, jr., C.E.; Belleville, swamps and low grounds, common, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; St Joy Woods, on the river shore, near Gatineau Mills, D. M'Gillivray, M.D.; Newfoundland, Miss Brenton, in Hook. Fl. Bor. Am.; Prescott, common, B. Billings, jr.; Nicolet, M. L'Abbé Provancher; L'Orignal, J. Bell; near London, W. Saunders.

O. Claytoniana, Linn.—Frond narrowly lanceolate, pinnate; pinnæ lanceolate, about three pairs of pinnæ near or below the middle of the frond contracted and fertile; sporangia brown, with green spores. This species, when fresh, has a strong odour, resembling that of rhubarb (Pie-plant) stalks. *O. Claytoniana*, Linn., Gray, J. Sm. *O. interrupta*, Michaux.—Between Kingston and Kingston Mills, in wet swampy places by the roadside; Little Cataraqui Creek; Waterloo; banks of the Humber, near Toronto; Princes Island, Hamilton, Judge Logie; Ramsay, Rev. J. K. M'Morine, M.A.; Ke-we-naw Point, in wet soil, R. Bell, jr.; Belleville, low rich grounds, not rare, J. Macoun; Prescott, common, B. Billings, jr.; Round Lake, W. S. M. D'Urban; Lake Settlement, and on the river shore near Gatineau Mills, D. M'Gillivray, M.D.; Newfoundland, Miss Brenton, in Hook. Fl. Bor. Am.; Osnabruck and Prescott Junction, Rev. Dr Epstein; on Judge Malloch's farm and elsewhere about Brockville; Dartmouth River, Gaspé, John Bell, B.A.; St Ferreol, M L'Abbé Provancher. Abundant on uncleared land along the Bedford Road, where the dried fronds are used by the farmers as winter fodder for sheep. Augmentation of Grenville, C. E., J. Bell, B.A.; near Komoka, C.W., W. Saunders. This fern is common also in the Northern States. I have a lax form, with long stipes and remarkably short somewhat triangular pinnæ, from Schooley's Mountains.

Schizæa.

[*S. pusilla*, Pursh.—Newfoundland, De la Pylaie. I have no further information respecting its occurrence in British America. Professor A. Gray indicates its distribution in the United States thus:—"Low grounds, pine barrens of New Jersey, rare," which is not at all favourable to its being found in Newfoundland or Canada. Mr Eaton has sent me beautiful specimens from sandy swamps in Ocean County, New Jersey.]

Nat. Ord. OPHIOGLOSSACEÆ.

Botrychium.

B. virginicum, Swartz.—Barren branch sessile, attached above the middle of the main stem, thin, delicate, veiny, tripinnate, lobes of the

pinnules deeply incised; fertile branch bi- or slightly tri pinnate. Very variable in size, usually a foot or more in height, but sometimes only a few inches. *Botrychium virginicum*, Swartz, A. Gray, J. Sm. *B. virginianum*, Schk. *Osmunda virginica*, Linn. Sp. Pl. *Botrypus virginicus*, Michx.—Not uncommon in the woods about Kingston and the surrounding country, as near Odessa, in Hinchinbrook, &c.; Delta; Toronto; Sulphur Spring, Hamilton, Judge Logie; Prescott, in woods, common, B. Billings, jr.; Nicolet, Montreal, Wolfe Island and Chippawa, P. W. Maclagan, M.D.; Belleville, rich woods, very common, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; River Marcouin, St Lawrence Gulf, also opposite Grand Island, Lake Superior, R. Bell, jr., C.E.; Marsoni, Riviere Rouge, and De Salaberry, west line, W. S. M. D'Urban; Montreal, Osnabruck, and Prescott Junction, Rev. E. M. Epstein; Hill Portage above Oxford House, Governor M'Tavish; Newfoundland, Miss Brenton, in Fl. Bor. Am.; Lake Huron to Saskatchewan, Hook. Fl. Bor. Am.; Gaspé, John Bell, B.A.; Stanfold, M. L'Abbé Provancher; Grenville, C. E., J. Bell; London, W. Saunders.

β. gracile.—Very small (5 or 6 inches high), fertile branch less divided. *B. gracile*, Pursh. Hill Portage, above Oxford House, Governor M'Tavish.

γ. simplex.—Barren branch oblong, pinnatifid, the lobes ovate, incised, veiny. *B. simplex*, Hitchcock. Grenville, C.E., John Bell, B.A.

B. lunarioides, Swartz.—Barren branch long-stalked, arising from near the base of the main stem, thick and leathery, bipinnate, the pinnules slightly crenate; fertile branch bipinnate. Root of long thick tuber-like fibres. *Botrychium lunarioides*, Swartz, Gray. *B. fumarioides*, Willd., Provancher. *Botrypus lunarioides*, Michx.—Gananoque Lake, May 1861; Plains near Castleton, and woods near the Hop Garden, Belleville, rare, J. Macoun; Three Rivers, C.E., P. W. Maclagan, M.D.; Waste places west from Prescott Junction, rare, B. Billings, jr.; St Joachim, Provancher; L'Orignal, J. Bell; English's Woods, W. Saunders; in the Northern States this species grows in dry rich woods, "mostly southward," according to Professor Gray's Manual.

B. obliquum (Muhl.), appears to be chiefly distinguished by its larger size, more compound fertile frond, and the narrower oblique divisions of the barren one. *B. obliquum* (Muhl.), Pursh. Fl. Amer. Sept., vol. ii. p. 656. Newfoundland, Dr Morrison in Hook. Fl. Bor. Am.; "Wesleyan Cemetery, London," W. Saunders.

B. Lunaria, Swartz.—Barren branch sessile, arising from the middle of the stem, thick and leathery, oblong, pinnate; pinnæ lunate or fan-shaped, slightly incised on the rounded margin. *Botrychium Lunaria*, Swartz, Schk., Hook., Moore, J. Sm. *Osmunda Lunaria*, Linn.—Nipigon, 1853, Governor M'Tavish; N.E. America, Dr Hooker's tab.; Newfoundland, Saskatchewan, and Rocky Mountains to Behring's Bay in N. W. Am., T. Moore, Hbk. Brit. Ferns.

OPHIOGLOSSUM.

[*O. vulgatum*, L., which is widely distributed throughout Europe and Northern Asia, and grows also in the Northern United States, although there "not common," is to be looked for in Canada. In one of its forms (*O. reticulatum*, Linn.), it extends to the West Indies.]

Nat. Ord. LYCOPODIACEÆ.*

PLANANTHUS.

P. Selago, Pallisot-Beauvois.—Stem dichotomously branched, erect, fastigiate; leaves in about 8 rows, more or less convergent or spreading, lanceolate, acuminate, entire; sporangia in the axils of the common leaves (not in spikes). *Lycopodium Selago*, Linn., E. B., Bigelow, Beck, Hook. and Grev., Torrey Fl. N. Y. ii. p. 508, Gray.—Labrador, Hudson's Bay to Rocky Mountains, Hook. Fl. B. A.; shore of Lake Superior and northward, Professor A. Gray, Man. Bot., N. S., p. 603. I have not seen Canadian specimens of this plant. The stations known show that it encircles Canada, and some of them are probably within our limits. Principal Dawson obtained the alpine variety on the White Mountains, Herb. Bot. Soc. Canada. It is a rare plant in the United States. There are two forms of this species (both of which are figured by Dillenius). *a. sylvaticus*, leaves convergent, almost appressed. *β. alpinus*, leaves widely-spreading, stems shorter.

P. lucidulus. Stem dichotomously divided into long erect branches; leaves bright green, in about 8 rows, reflexed, linear-lanceolate, acute, denticulate; sporangia in the axils of the common leaves (not in spikes). *Lycopodium lucidulum*, Michaux, Pursh, Bigelow, Torr. Fl. N. Y. ii. p. 508, Gray, Beck, Darlington, Hook. and Grev. Bot. Mis. *L. reflexum*, Schk. *Lycopodium suberectum* of Lowe, a Madeira plant. *Selago americana, foliis denticulatis reflexis*, Dill. Hist. Mus. t. lvi.—Gananoque Lakes, Collins's Bay, Newboro-on-the-Rideau, woods in rear of Kingston, &c.; Prescott, common, B. Billings, jr.; Nicolet, C.E., St Catherine's and Grantham, P. W. Maclagan, M.D.; Belleville, in swamps and cold woods, rather common, J. Macoun; River Ristigouche, St Lawrence Gulf, R. Bell, jr., C.E.; L'Orignal, J. Bell, B.A.; London, W. Saunders; Ramsay, Rev. J. K. M'Morine, M.A. This species is stated by Professor Torrey to be rather common in New York State. "Frequently bears bulbs instead of capsules," Pursh.

[*P. alopecuroides*, P. Beauv.—The habitat "Canada" is given for *Lycopodium alopecuroides*, Linn., in the "Species Plantarum," ed. 3, vol. ii. p. 1565; but it is probably not a Canadian plant.]

P. inundatus, P. Beauv.—Stems prostrate, adherent to the soil, the fertile ones erect; leaves secund, yellowish green, lance-awl-shaped, acute; sporangia in distinct, terminal, leafy, sessile, solitary spikes. *Lycopodium inundatum*, Linn., E.B., Michaux, Pursh, Beck, Tuckerman, Torr. Fl. N. Y. ii. p. 508, Gray. *Plananthus inundatus*, Beauv. *L. alopecuroides*, Linn., in part?—In cedar swamps and overflowed woods, Canada, Pursh. Professor Torrey notices its occurrence in the north-western part of the State of New York. Professor Gray observes, that the leaves are narrower in the American than in the

* In this order the arrangement of A. M. F. J. Pallisot-Beauvois is adopted, as it seems to afford the best basis for a readjustment of the genera of *Lycopodiaceæ*, which is much required. For P.-B.'s genus *Lepidotis*, I have thought it better to substitute the name *Lycopodium*, an old name that should not be discarded.

European plant, and suggests that it may be a distinct species. I have not yet seen Canadian specimens.

Lycopodium.

L. clavatum, Linn.—Stems robust, and very long, prostrate, rooting, forked, with short ascending branches; leaves pale, incurved, linear-awl-shaped, tipped with a white hair point; sporangia in scaly catkins, which are usually in pairs on common peduncles. *Lycopodium clavatum*, Linn., E. B., Michaux, Pursh, Bigelow, Beck, Darlington, Spring, Hook., Torrey, Gray. *L. tristachyum*, Pursh? *L. integrifolium*, Hook. *L. aristatum*, Humboldt.—Occasionally found in the woods in rear of Kingston, but not common; Newfoundland, Hook. Fl. Bor. Am.; between Thessalon and Missisaugi Rivers, Lake Huron, R. Bell, jr.; Prescott, common, B. Billings, jr.; Three Rivers, Temiscouata, and Wolfe Island, P. W. Maclagan, M.D.; Seymour, in pine woods, rare, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; River Ristigouche, St Lawrence Gulf, R. Bell, jr.; London, W. Saunders, C.E.; L'Orignal and L'Anse au Cousin, Gaspé, J. Bell; Belmont. The spores, chiefly of this species, constitute *pulvis lycopodii*, which is used by apothecaries, and was at one time employed for making artificial lightning in the theatres.

L. annotinum, Michaux.—Stems very long, prostrate, creeping, forked, with ascending branches; leaves bright green, spreading or slightly deflexed, in about five rows, linear-lanceolate, mucronate, serrulate; sporangia in scaly catkins, which are sessile, solitary, oblong-cylindrical, thick. *Lycopodium annotinum*, Michaux, E. B., Pursh, Beck, Tuckerman, Torrey, Fl. New York State, ii. p. 509.—Pine forests in Hinchinbrook; rocky woods in Pittsburg, on the north bank of the St Lawrence, near Kingston; Gananoque Lakes; L'Anse au Cousin, Gaspé, John Bell, B.A.; Prescott, common, B. Billings, jr.; Rivière du Loup, Nicolet, Montreal, and Kingston, P. W. Maclagan, M.D.; Belleville, in cool woods, common, J. Macoun; Ramsay, Rev. J. K. M'Morine, M.A.; Priceville, C. I. Cameron, B.A.; Newfoundland, Hook. Fl. Bor. Am.; St Augustin and Cap Tourmente, M. L'Abbé Provancher. Frequent in New York State, according to Professor Torrey. Of this species there are two forms, only one of which, the normal one, or type, I have as yet observed in Canada. The var. *β alpestre*, Hartm. Scan. Fl., having broader, shorter, paler, less spreading leaves, I have from the Dovrefieldt (T. Anderson, M.D.), Lochnagar (A. Croall), and entrance to Glen Fee, Clova, where I found it growing with the typical form.

L. dendroideum, Michx.—Stems upright, bare below, bushy above (giving the plant a tree-like aspect), arising from a long creeping rhizome, leaves more or less appressed; sporangia, in scaly catkins, which are sessile, cylindrical. *Lycopodium dendroideum*, Michx., Pursh, Bigelow, Hook., Beck, Darlington. *L. obscurum*, Linn., Bigelow, Oakes.—White cedar woods near Bath, abundant, and throughout the woods generally in rear of Kingston; Gananoque River; Priceville, C. I. Cameron, B.A.; Prescott, common, B. Billings. jr.; Nicolet, Mount Johnson, and Montreal, P. W. Maclagan, M.D.; Seymour and Cramahe, in cold moist woods, J. Macoun; River Ristigouche, Gulf of St Lawrence, R. Bell, jr.; Ramsay, Rev. J. K. M'Morine, M.A.; New

Brunswick, Hook. F. B. A.; Osnabruck and Prescott Junction, Rev. E. M. Epstein; London, W. Saunders; Harrington, L'Orignal, and Gaspé, John Bell, B.A.; St Joachim, M. L'Abbé Provancher.

L. complanatum, Linn.—Stems rhizome-like with ascending branches, which are dichotomously divided, flattened; leaves short, in four rows, those of two rows imbricated, appressed, of the other two somewhat spreading; sporangia in scaly cylindrical catkins, in twos, threes, or fours, on a common peduncle. *Lycopodium complanatum*, Linn., Gray, Blytt. *L. chamæcyparissias*, Braun. *L. sabinæfolium*, Willd.—Not uncommon in the woods about Kingston, and in rear; Newboro-on-the Rideau; Gananoque River; River Ristigouche, St Lawrence Gulf, and St Joseph's Island opposite Campment D'Ours, Lake Huron, R. Bell, jr.; Ramsay, Rev. J. K. M'Morine, M.A.; pine grove near Blue Church Cemetery and woodlands west from Brockville, not common, B. Billings, jr.; Three Rivers and Temiscouata, C.E., P. W. Maclagan, M.D.; sandy woods around Castleton, sterile hills Brighton and Murray, J. Macoun; L'Orignal and L'Anse au Cousin, Gaspé, J. Bell, B.A.; Trois Pistoles, M. L'Abbé Provancher; London, W. Saunders. To this species is referred *L. sabinæfolium*, Willd., *L. chamæcyparissias*, A. Braun, with branches more erect and fascicled. Professor Asa Gray remarks:—The typical form of *L. complanatum*, with spreading, fan-like branches, is abundant southern (in N. States), while northward it passes gradually into var. *sabinæfolium*." I have only one rather imperfect specimen of the European *L. chamæcyparissias*, collected at Bonn, on the Rhine, by my friend Professor G. S. Blackie, which does not differ in the branching from ordinary Canadian forms of *L. complanatum*. It appears to be quite a common species in the States, for I have it from a great many places.

Selaginella.

S. spinulosa, A. Braun.—Small, prostrate, leaves lanceolate, acute, spreading, spinosely toothed; fertile branch stouter, ascending spike sessile. *Selaginella spinulosa*, A. Braun, Blytt, Norges Fl. *Lycopodium selaginoides*, Linn., Pursh Fl. Am. Sept. ed. ii. p. 654. *Selaginella spinosa*, Beauv. *Selaginella selaginoides*, A. Gray, Man. Bot. N. States, p. 605.—Gaspé, John Bell, B.A.; Canada, Michaux; Lake Superior and northward, pretty rare, Professor Asa Gray in Man. Bot. N. States; Canada, Pursh, who observes: "The American plant is smaller than the European."

Stachygynandrum.

S. rupestre, P. Beauv.—Much branched, leaves slightly spreading when moist, appressed when dry, carinate, hair-tipped; compact and moss-like, growing on bare rocks. *Selaginella rupestris*, Spring, A. Gray, Eaton. *Lycopodium rupestre*, Linn., Pursh Fl. Am. Sept., ed. ii. p. 654.—On the perpendicular faces of Laurentian rocks, along the north bank of the St Lawrence, in Pittsburg, and on the Thousand Islands at Brockville, &c.; Longpoint on the Gananoque River; near Farmersville, C. W., T. F. Chamberlain, M.D.; rocks in pine groves two miles west from Prescott, near the river, and on rocks west from Brock-

ville, not common, B. Billings, jr.; Ramsay, Rev. J. K. M'Morine, M.A.; Beloeil and Mount Johnson, C.E., P. W. Maclagan, M.D.

Diplostachyum.

D. apodum, P. Beauv.—Stems creeping, branched; leaves pale vivid green, of two kinds,—the larger spreading horizontally, ovate-oblique, the smaller appressed, acuminate, stipule-like. Forms compact tufts. *Lycopodium apodum*, Linn., Pursh. Fl. Am. Sept. ed. 2, ii. p. 654. *Selaginella apus*, Gray, Eaton.—Abundant on low wet ground east of Front Street, Belleville, below the hill, where it was pointed out to me by Mr J. Macoun, July 1863. In September 1863, I found it sparingly but fertile, on grassy flats by the river side at Odessa. Near London, W. Saunders; Detroit River, C. W., P. W. Maclagan, M.D. Apparently not common in the United States. I have it from Schooley's Mountains. This is a very small, compactly-growing moss-like species, well adapted for cultivation under a glass shade. It was a great favourite with the late Dr Patrick Neill, in whose stove, at Canonmills, Edinburgh, I first saw it many years ago.

Nat. Ord. MARSILEACEÆ.

Azolla.

A. Caroliniana, Willd.—Pinnately branched with cellular, imbricated leaves; plant reddish, circular in outline, $\frac{1}{2}$–1 inch in diameter; leaves ovate obtuse, rounded and roughened on the back (Eaton). Resembles a floating moss or Jungermannia (Torrey). Gray, Man. Bot., t. 14. Floating on the waters of Lake Ontario, Pursh Fl. Am. Sept., ed. 2, ii. p. 672. In the adjoining states, Professor Asa Gray notices it as occurring in pools and lakes, New York to Illinois and southward, and observes that it is probably the same as *A. magellanica* of all South America.

Salvinia.

[*Salvinia natans* = *Marsilea natans*, Linn. Sp. Pl. "Floating like lemna on the surface of stagnant waters, in several of the small lakes in the western parts of New York and Canada."—Pursh Fl. Am. Sept. ed. 2, ii. p. 672. Professor Asa Gray states, that it has not been found by any one except Pursh, and he therefore omits it from his Manual of Botany of the Northern States.]

Isoetes.

I. lacustris, L.—Beloeil, C. E., P. W. Maclagan, M.D.; Saskatchewan, Hook. Fl. Bor. Am. This plant is spoken of by Pursh as growing in the Oswego River, near the Falls; and Professor Gray and others allude to it as not rare in the New England States. It should be carefully looked for in the numerous lakes and creeks of Upper Canada. It grows in muddy bottoms, forming green meadows under water. Much interest is attached to the genus *Isoëtes*, since Professor Babington has shown that instead of one there are many species, or at least distinct

races or forms, in Britain. In the United States four are known:—*I. lacustris*, Linn.; *I. riparia*, Engelm.; *I. Engelmanni*, Braun; and *I. flaccida*, Shuttlew., the last a southern form. Professor Babington is certain of the existence of at least eight European species:—*I. lacustris*, L.; *I. echinospora*, Dur.; *I. tenuissima*, Bor.; *I. adspersa*, A. Br.; *I. setacea*, Del.; *I. velata*, Bory.; *I. Hystrix*, Dur.; and *I. Duriæi*; Bory. As yet we know of only one Canadian species, which is here rendered, rather uncertainly, *I. lacustris*. The American species are described in Gray's Manual, the British ones in the new Journal of Botany, London.

Nat. Ord. EQUISETACEÆ.

Equisetum.

The *Equiseta* having been described in a previous paper, it will be sufficient to give here a mere list of the species, with some additional notes obtained since the former paper was written.

E. sylvaticum, Linn. Newfoundland and New Brunswick, Hook. Fl. Bor. Am.

E. sylvaticum, *β. capillare*. Much branched; branches very long, straight, and exceedingly slender (capillary). Farmersville.

E. umbrosum, Willd. Belmont.

E. arvense, Linn. West from London, W. Saunders. The rhizome bears large spherical pill-like nodules, which are, however, more conspicuous in var. *β. granulatum*.

E. arvense, *β. granulatum*.

E. Telmateja, Ehrhart. Shores of Lake Ontario, Beck.

E. limosum, *Fries*.—The great value of this species and of *E. arvense* as fodder plants, is confirmed. On the western prairies horses are said to get "rolling fat" on Equisetum in ten days; and experienced travellers tell me, that their horses always go faster next day after resting at night on Equisetum pasture. The horses do not take to it at first; but after having a bit of Equisetum put occasionally into their mouths, they soon acquire a liking for it, and prefer it to all other herbage. Near Komoka, W. Saunders.

E. hyemale, Linn. Lake Huron, Hook. Fl. Bor. Am.; St Joachim, M. L'Abbé Provancher; London, W. S.

E. robustum, Braun. Stems much thicker than in *E. hyemale*, the ridges with one line of tubercles; sheaths shorter than broad, with a black band at base, and a less distinct one at the margin; teeth about forty, three-keeled. *E. robustum*, Braun, A. Gray. Grenadier Pond, on the Humber River near Toronto, 3d June 1862. It is difficult to decide whether this and other forms are really distinct from *E. hyemale*; certainly that species varies in size, in roughness, and other characters. In *robustum* the teeth are twice as many as in *hyemale*, but even this is perhaps not a constant character.

E. variegatum, Weber and Mohr.; St Joachim, M. L'Abbé Provancher.

E. scirpoides, Michaux.

E. scirpoides, *β. minor*.

E. palustre, Linn.—"Canada, from Lake Huron, Dr Todd, Mr Cleghorn, Mrs Perceval, to the shores of the Arctic Sea, Dr Richardson,

Drummond, Sir John Franklin, Captain Back."—Hook. Fl. Bor. Amer. Professor A. Gray speaks of "the European *E. palustre*," "attributed to this country (the N. American States) by Pursh, probably incorrectly." Dr Hooker indicates its existence, without doubt, in Arctic West America and Arctic East America. The name of the plant has occasionally appeared in Canadian lists, but I have as yet seen no Canadian specimen. It remains for Canadian or Hudson's Bay botanists to trace its southern limit on the American Continent. In Europe and Asia it has no tendency to Arctic limitation.

III. *Notes on some New and Rare British Mosses, and on the Occurrence of* Trichomanes radicans *in the Island of Arran, Firth of Clyde.* By Mr John Sadler.

Bryum Duvalii, Voit.

Whilst lately engaged examining the genus *Bryum* in Dr Greville's collection of *Musci*, recently added to the University Herbarium, I came upon two barren specimens marked "*Bryum turbinatum*, Ben Voirlich, 1823." On close examination, I found them to be the true *Bryum Duvalii* of Voit. The specimens were collected by Dr Greville himself; thus he is the discoverer of the plant in Britain, having gathered it fully thirty years before the late Colonel Madden met with it near Waterford in Ireland, as recorded in the Society's Transactions, vol. vii. p. 6. The following are the known British stations for this moss:—

1. Ben Voirlich, 1823. Dr Greville.
2. Near Waterford, Ireland, 1852. Colonel Madden.
3. Hart Fell, near Moffat, 1858. Dr William Nichol.
4. Helvellyn, 1859. Mr John Nowell.
5. Ben Lawers, 1860. Mr William Bell.

Mnium stellare, Hedw.

On the Ochils, near Bridge of Earn. August 1863. J. S.

Grimmia leucophæa, Grev.

Rocks between Kinghorn and Pettycur. June 1863. J. S.

Schistidium maritimum, B. *et* S.

Rocks between Kinghorn and Pettycur. June 1863. J. S.

Didymodon recurvifolius, Tayl.

Ben Voirlich. 1863. Mr M'Kinlay.

Dicranum circinatum, Wils.

Ben Voirlich. 1863. Mr M'Kinlay.

Glyphomitrium Daviesii, Schwæg.

Bowling Glen. May 1863. Mr Galt.

In a letter which I lately received from Mr John Robertson, Glasgow, he says:—"I have been to Glen Turret and Ben Chonzie, and the following are some of the few rarities I collected. A solitary tuft of *Tortula tortuosa* in fruit, on Ben Chonzie; *Bryum roseum*, but not with capsules. In a fruiting state I found *Oligotrichum hercynicum*, *Tetraplodon mnioides*, *Splachnum ampullaceum*, *S. sphæricum*, *Encalypta ciliata*, *Climacium dendroides*, &c."

Mr Sadler exhibited specimens of *Trichomanes radicans* which he had received from Mr Walter Galt, Glasgow, accompanied by the following note, dated 26th August 1863:—"I enclose you fronds of *Trichomanes radicans*, collected by Mr George S. Combe in the Island of Arran, Firth of Clyde. It occurs in two separate patches, one of which is about 3 feet square, seemingly a natural habitat."

Dr Alexander Dickson presented flowering specimens of *Utricularia intermedia*, preserved in spirit.

10*th December* 1863.—Professor BALFOUR in the Chair.

The following Office-bearers for 1863–64 were elected:—

President.

Professor J. H. BALFOUR.

Vice-Presidents.

Professor ARCHER.
W. A. F. BROWNE, M.D.
Professor ALLMAN.
HUMPHREY GRAHAM, W.S.

Council.

CHARLES LAWSON, junior.
ISAAC ANDERSON-HENRY.
WALTER ELLIOT.
F. NAYLOR.
FINDLAY ANDERSON.
Professor MACLAGAN.
DYCE DUCKWORTH, M.D.
JOHN KIRK, M.D.
WILLIAM SELLER, M.D.
JAMES M'NAB.

Honorary Secretary.........ROBERT KAYE GREVILLE, LL.D.
Honorary Curator..........The PROFESSOR OF BOTANY.
Foreign Secretary............ALEXANDER DICKSON, M.D.
Auditor........................WILLIAM BRAND, W.S.
Treasurer......................PATRICK NEILL FRASER.
Artist..........................NEIL STEWART.
Vice-Secretary and Curator ....JOHN SADLER.

A letter was read from Major Cowell, conveying the thanks of H.R.H. Prince Alfred to the President and Fellows of the Society for his election as an Honorary Member.

The following Gentlemen were elected Resident Fellows of the Society:—

B. H. HOSSACK, Esq.
JOHN STEWART MACBETH, Esq.
HENRY BARNES, Esq.
SMITH H. DAVSON, Esq.

The following donations to the Library were laid on the table:—

Proceedings of the Royal Physical Society from 1858 to 1862.—From the Society.

Proceedings of the Royal Horticultural Society, Vol. III., No. 8.—From the Society.

The Characters, Actions, and Therapeutic Uses of the Ordeal Bean of Calabar, by Thomas R. Fraser, M.D.—From the Author.

Memoire sur la Famille des Guttifères, par J. E. Planchon et José Triana—From the Authors.

The following donations to the Herbarium were announced :—

From Mr W. H. Symes—Rare Plants collected in Surrey.

From Professor Harvey, per Dr Greville—Specimens of *Fucus distichus* from Kilkee, Ireland.

The following donations to the Museum at the Botanic Garden were noticed :—

From Messrs W. & G. Law—Tea from Japan, Assam, and Java; Coffee, Cocoa, and Chicory, raw, roasted, and ground.

From Mr John Scott—Spikes and Panicles of Maize ripened in the Botanic Garden.

The following Communications were read :—

I. *Notice of the Occurrence of* Polypodium calcareum, *near Aberdeen.* By Mr James Robertson.

Mr Robertson states that he had discovered this plant in August 1862, growing in the debris of a limestone quarry in Scotston Moor, near Aberdeen, along with *P. Dryopteris*. He was disposed to look upon the plant as being wild in that locality. Professor Dickie, however, believes that it has been introduced, and he has learned that a gentleman's gardener in the neighbourhood was in the habit of planting ferns in waste places. Specimens of the plant were exhibited from the Scotston station.

II. *Account of the Vegetation of the Cliffs of Kilkee, County Clare, Ireland.* By N. B. Ward, Esq.

In compliance with Professor Balfour's request, I send a brief account of the vegetation of the Cliffs of Kilkee, and its neighbourhood, which I visited last summer, in company with Professor and Mrs Harvey, and an old friend, Mr Snell, with my daughter. During our stay, we visited Loophead, at the mouth of the Shannon, and an intermediate portion of the cliffs, on which Baltard Castle is situated. Five days were spent at Kilkee, one at Baltard Castle, and one at Loophead. The vegetation at the three places was so perfectly identical, as to lead us to the conclusion, that the same geological structure prevailed throughout, consisting of hard grits, shales, &c., a conclusion which was confirmed by a subsequent visit to Mr Jukes of Dublin.

Kilkee is situated on the west coast of Ireland, exposed to the tide force of 2000 miles of unbroken seas,—the waves of which roll in with such power, as to furnish abundant food to periwinkles, located on rocks 200 feet above high water-mark, and to supply the wants of marine plants which cover the summits of cliffs varying in height from 150 to 400 feet.

That physiological law by which plants, under adverse circumstances, produce their flower and fruit, if they can do nothing else, is here strikingly exemplified. Looking at the stunted character of the vegetation, one might imagine oneself in a high alpine region—many species not attaining more than a tenth or twelfth of their usual size. Thus we find here a number of plants, simulating the appearance of the inhabitants of alpine regions—e. g., *Aster Tripolium*, in full flower, from half an inch to an inch and a half in height; and equally stunted, not starved, forms of *Samolus Valerandi*, *Euphrasia officinalis*, *Jasione montana*, *Erythræa Centaurium*, *Ranunculus Flammula*, &c. The higher portions of the cliffs are cushioned by continuous tufts of the common thrift, *Armeria maritima*, which, when in full flower, must be exceedingly beautiful. The lower grounds are carpeted by *Anagallis tenella*, *Ranunculus Flammula*, *Hydrocotyle vulgaris*, &c., whilst the hill sides are dotted with generally solitary plants of *Erythræa Centaurium*, the broad-leaved variety; the little ridges towards the sea are lined with *Glaux maritima*, the drier spots being covered with *Radiola Millegrana*, &c.

The following is a list of all the plants which were seen in flower:—

Ranunculus Flammula, in great abundance in wet places, towards the lower portion of the cliffs, in company with *Anagallis tenella*, *Juncus bufonius*, &c.; *Silene maritima*, *Spergularia rubra*, var. *marina*; *Radiola Millegrana*, on little elevated ridges; *Polygala vulgaris*, *Potentilla Tormentilla*, *P. anserina*, *Sedum anglicum*, the great ornament of exposed and bare rocks here and in many other parts of Ireland, from the beauty of its flower and the rich decaying tints of its foliage; *Aster Tripolium*, many specimens in full flower, not an inch in height; *Bellis perennis*, *Achillæa Millefolium*, *Senecio Jacobæa*, *Carduus pratensis*, *Leontodon autumnale*, *Calluna vulgaris*, very sparingly; *E. Tetralix*, very sparingly; *Jasione montana*, *Campanula rotundifolia*, *Glaux maritima*, coating the seaward face of the high ridges; *Anagallis tenella*, everywhere in moist places; *Samolus Valerandi*, *Euphrasia officinalis*, rarely exceeding half an inch in height; *Erythræa Centaurium*, *Thymus Serpyllum*, *Armeria maritima* cushioning the whole of the upper surface of the cliffs; *Plantago maritima*, *P. Coronopus*, *Juncus bufonius*, *Luzula campestris*, *Carex flava*, *Aira caryophyllea*, withered; *Melica cœrulea*, very sparingly. The paucity of grasses was remarkable.

III. *Notice of the Discovery of* Fucus distichus, *L.*, *at Duggerna, County Clare, Ireland.* By Professor Harvey.

In a letter to Dr Greville, Professor Harvey says:—

"In a summer excursion to Kilkee, last July, in company with N. B. Ward, we found what I take to be the true *Fucus distichus* of Linnæus. I have no authentic specimen of the Arctic plant, nor have I seen one, but the specimens exactly agree with the description of authors, as well as with the *figures*, though none of the latter do this plant justice. I enclose specimens for your herbarium. Unfortunately we were rather *late* in the season, and the fruit had mostly dropped off, leaving truncated branches. Some, however, were in fruit. I suppose it is in perfection either in winter or spring, and I mean, if I can manage it, to visit the station next Easter.

"It grows on a remarkable rock facing the sea, near low water *mark*, but rising much above low water *level*—that is to say, the rock is at the outer edge of a long reef, but rises above the reef level. The fucus grows in *patches* on little ledges of the perpendicular side of the rock, along

with *Gigartina mamillosa*, &c. It has quite a peculiar *aspect* when growing. The stipes or base of stem is thick and *rigid*, and stands erect, while the fronds are just sufficiently limber to bend over, but not to lie flat, so that the *patch* looks like a miniature grove of weeping willows."

In the University Herbarium (which now contains Dr Greville's algæ) there are specimens of *Fucus distichus* from Faroe, sent by Professor Hornemann, and from Newfoundland, sent by Bory in 1831, which appear to correspond with the Irish specimens.

IV. *Notice of the Occurrence of* Sagina nivalis (Lindblom), *on Ben Lawers.* By Professor Balfour.

In October last, Mr J. T. Boswell Syme, wrote to me in the following terms:—" Will you be so kind as to look in your herbarium under *Alsine rubella*, to see if you have got specimens of *Sagina nivalis*, Lindbl. Under this name, I have this plant with the following label from the Edinburgh Botanical Society, '*Alsine rubella*, Ben Lawers, Perthshire, Aug. 25, 1847. Dr Balfour.' I have come to the genus *Sagina* for the new edition of English Botany, and I feel great doubts as to whether or not I should include *S. nivalis*. Babington mentioned it in the third edition of his Manual, but omitted it from the fourth and fifth." On examining the plants in my herbarium and my duplicates, I found that three specimens of *Sagina nivalis* were fastened down on a sheet along with specimens of *Alsine rubella*. The specimens of the former were put together and quite distinct from the latter, implying that I had looked upon them as peculiar. They are marked 'Ben Lawers, 1847,' and they were gathered by me on the 25th August. There were only a few pupils with me, viz., Mr Charles Murchison, Mr F. J. Ivory, Mr Gilby, Mr Hewitson, Mr Hugh Balfour. Among my duplicates I could only detect two specimens remaining, one of which I sent to Professor Babington. I have no doubt that there are others which have been distributed, as a number of duplicates were contributed by me to the Society. In my notes of the excursion, I refer to our getting *Alsine rubella*, and from the indication given, I think that I know the particular locality. Babington refers to the plant as having been gathered on Glassmeal, by Mr Backhouse; and Hooker and Arnott, in the eighth edition of their " British Flora," mention *Sagina nivalis* as found in the Isle of Skye and Clova. They say that the plant is distinguished from *S. subulata*, by being almost quite glabrous. It is possible that their plant may be *S. saxatilis*. The genera *Alsine* and *Sagina* are very nearly allied. The chief characters are derived from the styles and valves of the capsule, which in *Alsine* are usually three, while in *Sagina* they are four or five. In *Alsine rubella* the sepals are distinctly 3-nerved, whereas in *Sagina nivalis* they are obscurely 1-nerved. By this character the plants can be easily separated.

I now show the original specimens gathered by me on Ben Lawers on 25th August 1847.

The following are the characters of the plant as given by Fries:—*Sagina nivalis*, Lindbl. Caulibus cæspitosis, foliis subulatis mucronatis glabris, pedunculis brevibus strictis, sepalis quinque ovatis obtusis membranaceo-marginatis petala integra vix æquantibus. Lindbl. "Bot. Not.," 1845, p. 66; Fries, "Summa Veg. Scand.," 156; Fries, "Nov. Mant." iii. 31; *Sagina intermedia*, Ledebour "Flora Rossica," i. 339; *Spergula saginoides*, *β. nivalis*, Lindbl. in "Phys. Sallsk. Tidskr.," 1838, p. 128; Arenaria cæspitosa, "Fl. Dan.," t. 2289.

The plant is found in moist places of the Dovrefeld. Gathered by

Lindblom at Sprenbacken in Kundshö, above Kongsvold, and at Drivelven. It is a perennial, and flowers in August and September. The discoverer of this plant states that it bears the same relation to *Sagina saxatilis*, that *Sagina stricta* bears to *S. procumbens*. The species exhibits two forms, one congested and erect, the other lax, with elongated procumbent stalks. The petals are entire, while in *Sagina saxatilis* they are slightly emarginate.

Babington states that he has specimens from Fries in his Herb. Norm. (xii. 51) gathered by Blytt in the Dovrefeld in Norway. He also says: " It is to be remarked that Blytt finds it in Norway, Fenzl has it from the extreme north-east of Siberia, and *Flora Danica* from Greenland."

V. *Remarks on the Sexual Changes in the Infloresence of* Zea Mays. By Mr John Scott.

The florets of the Indian corn, *Zea Mays*, as is well known, are unisexual, and so placed that the male florets form a terminal panicle, or raceme, and the females inferior lateral spikes. In the male panicle the spikelets are two-flowered; both florets perfect and characterised by two glumes, two squamulæ, and three stamens. In the female spike, the spikelets are also two-flowered, but in this case the inferior floret is neuter; two paleæ alone being developed, the superior fertile, and possessing two or three paleæ, an oblique, sessile ovary, and a long compressed style, bifid, and pubescent at the apex.

In the abnormal specimens which I now submit to the Society, the male and female florets, in place of being arranged as above, on distinct axes of the plant, occur more or less irregularly on a single axis. Thus, in specimen No. 1, we have a female monoicous spike; *i. e.* a female spike, producing both male and female florets. In this case the basal portion of the spike is normal, presenting several circles of the perfect grain; the upper and major portion of the spike, on the other hand, has every floret converted into the male form; each spikelet, be it observed, producing *two perfect male florets*. In other cases, however, the upper portion of the spike retains its feminine character, while the basal portion assumes the male; or again, we may have an irregular intermixture of male and female florets over the whole spike.

The metamorphosis of the female into the male floret is not, however, always complete, and this is more especially

so in such cases as the latter, where there is no definite arrangement of the male and female floret. From the special theoretical interest now attached to these imperfectly metamorphosed florets, in their association with others perfectly metamorphosed, I will here describe one or two of the most instructive which have come under my observation. *First*, In the *superior* floret of a female spikelet, the style was abortive, ovary rudimentary, squamulæ developed (though smaller than those of a normal *male* floret), glumes lanceolate-acuminate; in the *inferior* floret the stamens, squamulæ, and glumes were perfectly developed; so that the normally *neuter* floret of the female spikelet was in this case converted into a *perfect* male; whereas a very imperfect metamorphosis has been effected in the case of the fertile female floret. Again, *second*, in another spikelet, from a female spike, I found the *superior* floret presenting all the characteristics of the *normal male* floret; while the *inferior* (though still retaining its neutrality of function) —stamens and pistils being alike abortive—presented by a pair of lanceolate acuminate glumes, and two minute cuneate squamulæ, an evident tendency to assume the male form also.

If we now turn to an examination of the male panicles, we are at once struck with the rare occurrence of the monoicous structure in them, as compared with the occurrence of such a structure in the female spikes. Somehow—and it is difficult to understand why it should be so—the female organs in this instance, as indeed in most other unisexual plants, are much less prone to become developed in the male flowers than are the male organs in the female flowers.*

* May we not regard this as probably indicative of those homological distinctions between the male and female organs of plants, insisted upon by Schleiden and Endlicher, at least as modified by Dr Dickson, in his interesting paper "On the Nature of the Cormophyte." (*Vide* Society's Transactions, vol. vi. p. 95.) Dr Dickson there states, that he is "inclined to believe that there exist in reality two modes of placentation, the one where the ovules are produced by a process of gemmation from the carpellary leaves (*parietal*); the other, where the ovules spring from the prolonged floral axis (*central*). In this modified sense, then, a strong argument against the Schleidonian theory of placentation is completely neutralised. I refer to the *inverse* convertibility of male and female organs in certain plants. For example, in the willows, we have some excellent illustrations in the Society's Transactions. Thus, in vol. i. page 118, the Rev. J. E. Leefe has illustrated the gradual modifications of the pistillary into staminal organs in the *Salix Caprea;* while

On this account, then, I trust the Society will bear with me while I briefly attempt to describe the few male monoicous panicles, which I have been fortunate enough to obtain; they are as follows:—

First, In specimen No. 2,—a terminal panicle,—the primary axis bears male and female florets; the florets of the former are perfect in the upper portion of the axis, which they exclusively cover, but in the lower portion, where they approach the female florets, the superior floret in the majority of the spikelets is alone perfect; while in the inferior floret the stamens occur in a more or less rudimentary condition. The female florets of the primary axis are *all imperfect*, the ovary existing in a rudimentary form, and the stamens utterly aborted in the *superior* florets; whereas, in the inferior florets of the spikelets, staminal and pistillary organs are similarly aborted. Again, in the arrangement of the male and female florets in the secondary axes, a similar plan is observed to that of the primary axis; the female florets occupying their basal portions, but in several instances *perfectly* developed, the upper portions being covered with *perfect male* spikelets.

Secondly, In specimen No. 3,—a terminal panicle,—we have a very irregular intermixture of perfect and imperfect male and female florets, along with several structurally *hermaphrodite florets*. Generally speaking, however, in this specimen, as in No. 2, the upper portions of both primary and secondary axes still retain their normal-male-sexual characteristics, and the basal portions assuming the female characters. By a careful examination, however, I have detected several structural peculiarities in certain florets of the latter part, to which I am inclined to attribute a highly important theoretical signification, as will be seen subsequently. The

Mr Lowe, vol. v. p. 113, has given us, *vice versa*, all the conceivable intermediate stages in the transformations of the staminal into the pistillary organs in *Salix Andersoniana*. Now, as these cases of the willows naturally come under the division assumed to possess a *parietal placentation*, their evidently disproving tendencies are utterly invalidated. And thus, even in view of such anomalous occurrences, we may justifiably reiterate the above suggestion, as to the difference in the *inverse* convertibility of the male and female organs, in at least the case of the maize, where the floral axis, as terminal shoot, undistinguishable in the cavity of the germen as a special organ, bears a single seed-bud (Schleiden's "Principles of Botany," p. 386), and is thus referrible to the division characterised by a central placentation.

following are the most instructive :—*First*, In the *superior floret* of a spikelet, presenting the broad glumes and paleæ of the female florets, I found a rudimentary *hypogynous stamen ;* while in the *inferior floret* the glumes were *ovately*-lanceolate, squamulæ as usual in normal *male* florets, stamens developed, but *destitute* of *pollen. Second* spikelet ; glumes of *superior floret broadly*-lanceolate, squamulæ cuneate, obliquely truncate, larger than those characteristic of the male florets, ovary and style incipient, as in the above ; but in this case I found *two* rudimentary *stamens*, one consisting of the filament alone, the other of the filament and a pellucid rudimentary anther, presenting the appearance of a glandular hair ; the only modification the *inferior* floret of this spikelet had undergone from its normal male condition, was the non-development of the pollen, the anther-cases being quite empty. *Third* spikelet ; glumes of *superior* floret *ovately*-lanceolate, squamulæ cuneate, minute, anthers destitute of pollen ; *inferior* floret functionally a perfect male, glumes *broadly*-lanceolate, squamulæ as usual in male florets, anthers containing pollen.

These, then, are the more interesting peculiarities which I have observed in the structure of the florets in the above panicle ; and there is just one other point in connection with it to which I will here specially direct attention,—namely, the remarkable irregularity observed in the relative arrangement of the male and female florets. The most striking case is presented by one of the secondary axes ; the florets in its basal portion are nearly all converted into more or less perfect *females*, whilst those above retain in like manner the male characteristics. Associated with the latter, however, and near the upper extremity of the axis, *two solitary female* florets are at once observable by their prominently developed grains. On examination of the spikelets bearing these, I find that the female morphogenesis is complete, the *superior* floret alone fertile, the *inferior* neuter. This individual isolation of the florets, occurring as they do in distinct parts of the axis, and surrounded by normal male florets, and perfect metamorphosis, excellently illustrates the occasional independence of such phenomena on mere physical conditions.*

* Dr Lindley in treating on the changes of sex under the influence of ex-

Thirdly, In specimen No. 4—a terminal panicle—a somewhat different arrangement is observed to that which we have seen followed in specimens Nos. 2 and 3. In the latter two, the basal portions of the axes produce female florets, and the upper male; whereas in the former, No. 4 specimen, the opposite of this occurs, namely, the upper portions of primary and secondary axes converted into *compact spikes* of *female* florets, while the lower portions, retaining their normal characters, continue to produce the racemose male spikelets. In the majority of the secondary axes, however, the basal spikelets are nearly all aborted; whereas this portion of the primary axis is covered with perfect male spikelets, which, as they extend upwards, are *abruptly* metamorphosed into a short terminal spike of female florets. These, like those on the secondary axes, are all very imperfect, the ovary and style existing in a more or less rudimentary condition, and occasionally presenting the rudiments of one or two hypogynous stamens.

Hitherto our remarks have been chiefly confined to a mere description of the sexual metamorphoses in the florets of maize, though I have more than once alluded to their possible connection with, and elucidation of, certain highly important points in theoretical natural science. For the sake of clearness in the exposition of the theoretical bearings of these metamorphoses, I will now give a brief *resumé* of the foregoing illustrations. First, then, we have stated that the inflorescence is normally unisexual—the female

ternal causes (*Introduction to Botany*, vol. ii. 4th ed. p. 80), states "that Mr Knight long ago showed that a high temperature favoured the development of male flowers, and a low one that of female;" furthermore, that this eminent horticulturist "entertained little doubt that the same fruit-stalks might be made to support either male or female flowers in obedience to external causes." Dr Lindley illustrates these conclusions by experiments on water-melons and cucumbers. From personal observations, however, on several monoicous plants, I cannot think that these influences are at all definite as to their influence on sex produced. The above laws are still less applicable to dioicous plants; and certainly, upon any theory of special creation; on a subjective consideration of the vegetable individual, I fail to see why they should not be equally potent in the one case as in the other. Such cases as those above noticed in the maize, in which collateral florets assume distinct sexual characteristics, induce me to believe that in general the influence of physical condition on the change of sex is subordinate to certain innate, specific, formative qualities; in short, an inherited tendency to produce the characters in question.

florets borne on inferior lateral spikes, the male on terminal racemes or panicles. Our illustrations, however, show that these structural arrangements undergo important modifications. Thus, we have first the female spikes assuming a monoicous structure, and this without any regard whatever to the relative axial arrangement of the male and female florets; the same part on distinct axes indifferently producing perfect and imperfect male or female florets, as well as collateral mixtures of both; showing us most conclusively, their morphogenetic independence of the mere external conditions of life. Again, individual florets of these female spikes present themselves with a structure intermediate between that of the perfect male and female; and then manifest a most interesting and instructive co-related order in the development of their organs. Thus the *superior* and normally *fertile* floret of a spikelet with abortive style and rudimentary ovary, had assumed the characteristic squamulæ and glumes of the *male* floret; while the normally *neuter* floret had assumed *in toto* the male characteristic.

In the terminal male panicles, with a similar series of changes to those which we have noticed in the female spikes, there are also the important additional illustrations of *structurally hermaphrodite* florets.* Thus, in one of the spikelets we had a *superior* floret with incipient ovary and style, a *rudimentary stamen*, and the characteristic paleæ and glumes of a *normal* female floret; while the *inferior* floret differed from a normal male only in its *broader* and *shorter* glumes, and *barren* stamens. Again, in the *superior* floret of another male spikelet, with glumes somewhat intermediate between those of the normal male and female florets, we noticed an incipient ovary and style, and *two* rudimentary stamens; while the inferior floret of the same spikelet retained its *male* characteristics.

What now are we to say as to the cause of these changes?

* I may state, that although I have failed in illustrating structural hermaphroditism in the female spikes, cases are already recorded. C. F. Gärtner, in his "Beiträge zur Kenntniss der Befruchtung," notices the occurrence of solitary stamens in the female florets of *Zea Mays;* he also states that he has observed in the conversions of male into female florets, a solitary stamen associated with the pistillary organ of the latter.

We see the unisexual florets of the maize not only undergoing inverse metamorphoses, *i.e.*, the male converted into female florets, and the female into male florets, but also assuming every conceivable intermediate stage between these and a structural hermaphroditism. Now, it is well known that similar sexual changes occur in—at least the female florets—many other monoicous and dioicous plants; *e.g.*, in the *Melandryum prætense*, and the *Lychnis dioica*, the female flowers occasionally become bisexual by the development of the stamens. I may also state that I have observed bisexual (female) flowers on the *Littorella lacustris*, *Bryonia dioica*, and *Ricinus communis*.*

Seeing, then, that unisexual flowers undergo such serial transformations in their sexual characteristics, we, on the ordinary theory of creation—*i. e.*, assuming species as the original units—might justly expect a similar series of changes in the characteristics of bisexual flowers. This, however, as is well known, is not the case; no instance can be adduced of a bisexual species undergoing sexual metamorphoses similar to those above described in the unisexual maize. Moreover, supposing that the sexual characters of hermaphrodite plants had exhibited masquerading tendencies similar to those of unisexual plants, it is at once evident, that, upon any theory of special creation, the *cause* of such changes in either case is equally unintelligible. On the other hand, if, with Mr Darwin, we believe that species are the modified descendants of previously existing species, these phenomena are no longer enigmatical, but clearly the results of definite and well-known laws. I need only refer to Mr Darwin's interesting papers on the distinct sexual forms of the dimorphic species of Primulas and Linums, "Jour. Linn. Soc.," vol. vi. p. 77, and vol. vii. p. 69, by way of illustrating, as has been remarked, "the possibility of a plant becoming dioicous by slow degrees." Now, if we reflect on this dimorphism of the Primulas and Linums, those differences in the variability of the unisexual, relatively to the bisexual flowers, are, I believe, readily explicable on the supposition that the latter—*i.e.*, the herma-

* I will not here enter on details as to the occurrence of the above, as I hope at some future time to lay them before the Society in a notice of my observations and experiments on the subject of *Vegetable Parthenogenesis.*

phrodite structure, as Professor A. Gray has maintained—*vide* "Sill. Amer. Jour.," vol. xxxiv.—"is the *normal* or *primary* condition of flowers." In fine, then, in accordance with the theory of modification with descent, I, inferentially guided by that principle of reversion to type so much insisted upon by those opposed to derivative hypotheses, look confidently at such sexual changes as those above described, as retrogressive tracings of the graduated modifications by which an original hermaphrodite progenitor gave rise to a monoicous offspring.

VI. *On the Cultivation of the Quiniferous Cinchona in British Sikkim.* By Dr Thomas Anderson, Superintendent of the Botanic Garden, Calcutta.

The cultivation of Cinchona at Darjeeling, has been carried on successfully. The following is a return of the Cinchona plant in the nurseries at that place, on the 15th June 1863 :—

Cinchona succirubra, ...	1024
C. Calisaya, ...	53
C. officinalis, ...	573
C. micrantha, ...	695
C. pahudiana, ...	2275
Total, .	4620

The cultivation of Cinchona at Darjeeling was attended with very great difficulties at first; but these have now been overcome, and there is every reason to believe that the plantation will be successful.

In the commencement of June 1863, I supplied Dr Simpson, the European Civil surgeon of Darjeeling, with about two lbs. of fresh leaves of each of the following species: *C. succirubra*, *C. officinalis*, and *C. micrantha*. Decoctions prepared with water slightly aciduiated with sulphuric acid, were very bitter, and three patients suffering from well-marked intermittent fever were cured by the administration of these preparations alone. Towards the end of June Dr Simpson and I endeavoured to examine chemically the nature of the leaves of *Cinchona succirubra*, and detected quinine in them.

VII. *On the Cultivation of Tea in India.* By William Jameson, Esq., Surgeon-Major, Superintendent of the Botanic Garden, Saharunpore.

In a former communication I estimated the quantity of waste and other lands fitted for cultivation with Tea, throughout the Kohistan of the North-Western Provinces, and Punjab, and Dhoons, and showed that by them the enormous quantity of 385,000,000 lbs. might be there raised. But in this estimate I excluded the Kohistan of Huzarah and Rawul Pindee, of Cashmere, Jummoo, and the protected Seikh States. The following estimate of the yield of the British territory is nearer the mark, and as a general return when in full bearing, 100 lbs. per acre may be given :—

	Acres.	100 lbs. per Acre.
Kohistan of Rawul Pindee and Huzarah, ...	20,000	2,000,000
Kangra Valley, . . .	35,000	3,500,000
Kazloo, ...	35,000	3,500,000
Munndee, &c., . . .	40,000	4,000,000
Protected Hill States, . .	10,000	1,000,000
Jonsar Bawer, . . .	10,000	1,000,000
Dehra Dhoon, ...	100,000	10,000,000
Western Gurhwal . . .	180,000	18,000,000
Kumaon, ...	3,500,000	350,000,000
	3,930,000	393,000,000

—a quantity nearly equal to the whole export trade of China, and with high cultivation the figures might easily be doubled, and thus not only allow an immense quantity for the consumption of the Indian community, but at the same time afford a vast supply for export to other countries.

In February last, at the request of the Lieutenant-Governor of the Punjab, I proceeded to the Kohistan of the Rawul Pindee Districts and Huzarah, there to establish the Tea plant, which has been most successfully done—the plants removed from the Kangra Plantations, and transplanted at Seelah, now growing with vigour.

It is no longer an experimental Tea cultivation in the North-Western Provinces, it having passed from experiment to fact. It has been proved by data which cannot be gainsaid, that the cultivation of the Tea can be profitably conducted; that the Tea prepared is admirably fitted for the Home and Indian markets; and that, if properly conducted and backed by capital, the undertaking presents a safe and profitable investment.

VIII. *On some Economic Plants of India.* By Dr Hugh F. C. Cleghorn.

1. The Box Tree (*Buxus sempervirens*).—This tree, grown at Koolor, has been tested by Dr Alex. Hunter, at the Madras School of Arts, and the wood is found valuable for engraving.

In Mr M'Leod's arboretum at Dhurmsalla the tree grows well. The arboretum contains many introduced Himalayan trees of great interest, as well as many European fruit trees adapted to this hill station. It is, perhaps, the only collection of indigenous alpine trees in the Punjab, the nearest to it being that of Mr Berkeley at Kotghur. I hope the day is not far distant when the Punjab Agri-Horticultural Society will have a hill garden associated with it at one of the sanitaria of the province.

The Himalayan box appears to be identical with the tree common all over South Europe, from Gibraltar to Constantinople, and extending into Persia. It is found chiefly in valleys at an elevation of 3000 to 6000 feet. I have met with it from Mount Tila, near Jhelum, to Wangtu bridge on the Sutlej. It is variable in size, being generally 7 to 8 feet high, and the stem only a few inches thick, but attaining sometimes a height of 15 to 17 feet, as at Mannikarn in Kullu, and a girth of 22 inches as a maximum. The wood of the smaller trees is often the best for the turner and wood-engraver. It is made into little boxes by the villagers for holding ghee, honey, snuff, and tinder. At the medical stores in Sealkote it is turned into pill-boxes, and it appears to be adapted for plugs, trenails,

and wedges. The wood is very heavy, and does not float; it is liable to split in the hot weather, and should be seasoned, and then stored under cover.

2. The Olive, *Zaitoon*, which has also been tested for wood-engraving at the Madras School of Arts, is another plant of the Mediterranean flora, which ranges from the coast of the Levant to the Himalaya. It varies a good deal in the shape of its leaves and in the amount of ferruginescence, hence the synonyms *cuspidata* and *ferruginea*, but it does not appear to differ specifically from the *Olea europæa* (Mount of Olives), the emblem of peace and plenty. The finest specimens I have seen are in the Kaghan and Peshawur valleys, where the fruit resembles that of rocky sites in Palestine or Gibraltar. The wood is much used for combs and beads—and is found to answer for the teeth of wheels at the Madhopore workshops.

3. *Urtica heterophylla*, a kind of Indian nettle, is plentiful in Simla, having followed man to the summit of Jako, attracted by moisture to an elevation unusual for any member of the family. It is found within the stations of Dalhousie and Dharmsalla, and at many intermediate points. The quantity is surprising wherever the soil has become nitrogenous by the encamping of cattle. The growth at this season (July) also is luxuriant in shady ravines near houses, where there is abundance of black mould; but the sting being virulent, the plants are habitually cut down as a nuisance, both by private persons and municipal committees.

There are other plants of the nettle tribe, particularly the *Boehmeria salicifolia*, "siharu," used for making ropes (to which attention has been directed by Dr Jameson); this plant does not sting, and is abundant at low elevations. The produce of this might be turned to good account, though not yet recognised as merchantable fibre.

4. *Cultivation of Bamboo.*—Mr M'Leod, Financial Commissioner in the Punjab, writes thus to the Commissioners of Umballa and Jullundhur:—

"As it is desired to extend the growth of the bamboo as widely as possible throughout the Punjab, and some of the districts of your division possess them in greater or less abundance, I have to request that you will ascertain whether any of the four following varieties have borne seed during the present year, and inform me of the result of your inquiries:—

1. The hollow Bamboo of the plains.

2. Solid Bamboo of the lower hills, of which spear handles and clubs are usually made.

3. The Nirgali or small Bamboo of the hills, growing at elevations from 5 to 8000 feet.

4. The Garoo, or still smaller hill Bamboo, growing at higher elevations, probably up to 12,000 feet.

"It would be interesting also to ascertain, if possible, from the people, the intervals which lapse between the seasons of flowering of the several varieties—a point on which the more observant might readily furnish information, as, after flowering and yielding seed, the entire tract of bamboo which has seeded, simultaneously dries up and perishes, fresh plantations springing up from the seeds which have been scattered by the old stock.

IX. Dr Alex. Hunter, Secretary of the Agri-Horticultural Society of Madras, transmitted reports as to the cultivation of Peruvian cotton at Chingleput by Dr Shortt, and in the Kistna District by Mr E. B. Foord. Both reports are satisfactory. The following is a statement which he also transmitted:—

***Statement showing the Quantity of Cotton carried on the Madras Railway in the Years* 1861–62 *up to June* 1863.**

	1861. Indian Maunds, or 82 2-7 lbs.		1862. Indian Maunds, or 82 2-7 lbs.		1863. Indian Maunds, or 82 2-7 lbs.	
January, ...	6,846	10	694	0	7,886	10
February, . . .	10,519	10	3,535	30	10,305	...
March, ...	6,134	15	3,346	10	4,471	30
April, ...	1,390	30	5,466	30	13,597	30
May, ...	3,046	20	21,795	10	50,500	20
June, ...	7,238	30	17,457	10	71,193	18
	35,175	35	52,295	10	157,954	28
July, ...	8,174	20	29,499	20	...	...
August, ...	6,357	20	20,381	0	...	...
September, . . .	3,721	30	24,979	10	...	...
October, ...	5,043	30	14,173	0	...	...
November, . . .	6,836	20	16,157	30	...	...
December, . . .	12,607	20	17,151	20	...	...
Total, . . .	77,917	15	174,637	10	175,954	28
Average per month in the 1st 6 months, . . .	5,862	25	8,715	35	26,325	31
Average per month in the year, ...	6,493	4	14,355	4	26,325	31

***Table showing the Monthly Export of Cotton from Madras, and its Official Value from* 1860 *to* 1863.**

	1860.		1861.		1862.		1863.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.
January,	4,973	82,154	11,162	1,52,904	10,340	2,09,191	7,312	3,35,555
February,	5,605	1,02,290	26,439	3,53,754	9,096	1,87,300	24,485	11,96,878
March, .	7,499	1,09,380	6,035	89,637	12,820	2,52,881	25,780	12,68,855
April, .	10,591	1,66,235	6,748	1,30,242	7,430	1,80,941	12,755	6,44,705
May, . .	5,010	78,105	11,247	1,68,556	17,433	3,89,017	26,260	14,36,706
June, .	1,663	25,132	20,113	3,12,498	36,115	8,80,529	55,875	31,00,255
July, . .	5,829	1,04,696	15,528	2,51,887	35,114	9,46,471	75,269	43,03,488
August, .	21,246	3,22,288	21,061	3,40,859	39,062	15,94,115	...	...
September,	4,661	69,988	5,750	95,312	39,262	18,69,655	...	...
October,	19,003	2,65,371	6,391	1,17,888	5,749	2,85,660	...	...
November,	11,961	1,48,934	7,615	1,44,850	10,264	5,12,605	...	...
December,	6,992	1,01,454	2,315	46,747	18,844	3,28,133	...	...
	105,033	15,76,027	140,404	22,05,134	2,41,529	82,36,498	...	...

Dr Hunter also reports that the American Saw Gin for cleaning cotton has been introduced with great success.

X. *Extract of Letter from* William Jameson, Esq., Surgeon-Major, Saharunpore, to Professor Balfour, July 9, 1863.

I send two small packets of seeds.

1. Seeds of the Folel or Phulwah (*Bassia lutyracea*) which is now just ripening here. From the seeds of this tree a kind of butter is extracted which is valuable in rheumatism. It is used in lamps, and as it gives a fine inodorous light, it is prized for night-lights. The tree grows to a height of from 30 to 40 feet, flowers in October, and ripens its seeds in July. It was supposed to be confined to Eastern Kumaon and Nepal, but this is a mistake, as it is common at Bhimtal, where I have an extensive tea-plantation. Bhimtal is ten miles from the plains and twelve from the Sanatarium at Nynee Tal. The Folel or Phulwah is met with growing at altitudes of from 4000 to 4500 feet. It will do well therefore in your green-houses, but it is not sufficiently hardy to withstand your winters. Where it is met with snow falls annually, but only remains a short time on the ground.

2. Seeds of Bamboo (*Bambusa arundinacea*), which flowered this year in the garden at Saharunpore. Other plants of Bamboo also flowered last year. As the flowering of the Bamboo rarely occurs in our gardens, and as the seeds appear to be good, a small supply may be useful to you.

I also enclose a few seeds of *Eremostachys superba*, which may be a novelty. It flowers in April, and is met with in hot, low localities, as at the Chowki, in the Mohur Pass, in the Sevalik range, and at Jewalah Moki in the Kohistan of the Punjab.

The museum building in the Saharunpore garden is now progressing rapidly, and I trust to see it finished about the end of the season. When filled with specimens, it will, I trust, be one of the most interesting collections in India. I am collecting botanical specimens useful in the arts and sciences from all parts of India, and as soon as the collection is sufficiently extensive a catalogue will be printed.

Two great exhibitions of arts and manufactures are to take place in India,—one at Lahore in November and December 1863, and the other at Calcutta in January 1864. In these we have a move in the right direction, as, under one roof, all the raw products and the articles manufactured in the respective countries will be brought together, and the wants and requirements of each district ascertained; at the same time there will be shown what each can give in return and send respectively into the market.

To open up the country, railways are rapidly extending; but amongst the engineers the cry is—We have no sleepers. Over hundreds of miles in the Himalayas the Cheer (*Pinus longifolia*) is met with in millions, forming trees from 10 to 18 feet in girth four feet from the ground, and in height varying from 80 to 120 feet. These noble trees are every where, I might say, met with in the mountains at altitudes from 3000 to 6000 feet—occurring in two varieties; one has the wood white and twisted, and easily acted on by the weather, and thus useless in architecture or for railway sleepers; the other, generally met with on the northern slopes of mountains at altitudes of from 5000 to 6000 feet, has reddish-white timber, close-grained and highly resinous. This timber of these trees, of which millions occur in the Himalayas, is admirably fitted for architectural purposes, and if kyanised or creozotised would also make first-rate sleepers for railways. Nothing, however, has been done, and the cry of the engineers is,—We cannot get on with our work, because the trees met with in the country yielding timber, fitted for sleepers, are limited. To remove this impression, so far as the North-West Provinces are con-

cerned, I am doing my endeavour, and ere long I trust to see the so-called difficulty to the rapid progress of railways overcome. When once the railways are finished, Government, particularly that of the Punjab, will, through time, find difficulty in feeding the engines, unless every where measures be taken to plant the finest tracts which are now being felled. In the Punjab, only two short lines are open,—one at Moultan, the other between Amritzur and Lahore,—and, with this small drain, firewood has risen 150 per cent. in value. Timber has from time immemorial been felled in the most reckless manner; and only now are the forests beginning to receive the attention that they deserve. Madras and Bombay have for a time been doing something; but as yet no regular plan has been pursued in the North-West Provinces. Numbers of parties were allowed to fell timber, and did so recklessly; so much so that first-class timber of Sal (*Shorea robusta*)—a timber admirably fitted for railway purposes—had, in many of the fine forests at the base of the Himalayas, become scarce, and hence the outcry of the engineers. But there are many other timber trees, admirably fitted for railway purposes, which, through sheer ignorance, have been passed over, such as the Sar (*Pentaptera tomentosa*), Backha (*Anogeissus latifolius*), Dhowlah (*Lagerstræmia parviflora*), Huldou (*Nauclea cordifolia*), &c. In the Kohistan of the North-West Provinces and Punjab there is no chance of coal being found, the formation being altogether wanting.

I have now established the Cinchona plant in two localities in the Himalayas, in Gurhwal, and the west of Mussouree, at altitudes of from 4800 to 6000 feet. The following species have thus been introduced:—*Cinchona Condaminea*, *C. succirubra*, *C. peruviana*, *C. nitida*, and *C. micrantha*.

XI. Mr M'Nab's *Report on Plants in Flower in the Botanic Garden.*

To give some idea of the mildness of the present season, I beg to lay before the Society dried specimens of 220 species of plants in flower, collected from the open air in the Royal Botanic Garden since the 1st day of December; the largest proportion being the summer and autumn annual and perennial plants, the others chiefly composed of trees, shrubs, and spring flowering plants in the following proportions:—

Annual plants (summer and autumn),	34	species.
Perennial plants. do. do.	118	...
Trees and shrubs,	38	...
Ferns,	8	...
Spring flowering plants,	22	...
	220	

The 220 species are spread over 50 natural orders in the following proportions:—

Natural Orders.	No. of Species.	Natural Orders.	No. of Species.
Ranunculaceæ,	9	Caryophyllaceæ,	11
Berberidaceæ	2	Hypericaceæ,	1
Fumariaceæ,	1	Geraniaceæ,	3
Cruciferæ,	17	Rutaceæ,	1
Resedaceæ,	2	Rhamnaceæ,	1
Violaceæ,	4	Leguminosæ,	7
Polygalaceæ,	1	Rosaceæ,	17

Natural Orders.	No. of Species.	Natural Orders.	No. of Species.
Myrtaceæ,	2	Labiatæ,	13
Onagraceæ	1	Verbenaceæ,	1
Portulacaceæ,	1	Primulaceæ,	4
Umbelliferæ,	4	Plantaginaceæ,	2
Araliaceæ,	1	Polygonaceæ,	2
Loranthaceæ	1	Thymelæaceæ,	1
Caprifoliaceæ,	2	Euphorbiaceæ,	2
Valerianaceæ,	1	Urticaceæ,	2
Dipsacaceæ,	3	Corylaceæ,	2
Compositæ,	26	Garryaceæ,	1
Campanulaceæ,	3	Coniferæ,	4
Ericaceæ,	13	Iridaceæ,	2
Aquifoliaceæ,	1	Liliaceæ,	2
Jasminaceæ,	1	Naiadaceæ,	1
Apocynaceæ,	3	Cyperaceæ,	1
Gentianaceæ,	1	Gramineæ,	8
Polemoniaceæ,	3	Filices,	9
Boraginaceæ,	4		
Scrophulariaceæ,	16	Total,	220

Miss Hope sent specimens of fifty species of plants in full flower, growing in the open air at Wardie.

Isaac Anderson Henry, Esq., Hay Lodge, exhibited sprigs of blossom taken from two separate pear trees growing in the open air in his garden. The one tree has been covered with blossom for the last fortnight, the other is just beginning to burst its flowers.

Mr John Sadler exhibited branches of apricot in full foliage, from the open wall in the Experimental Garden. The trees, although deciduous, have as yet lost none of their last summer foliage, owing to the mildness of the season.

Dr Alexander Dickson exhibited flowering stalks of a species of Indian hollyhock from his greenhouse at Hartree.

A note was read from Dr Dickie, Aberdeen, referring to several old works on natural history, illustrated by nature printing, and in which a full account of the process was given.

14th January 1864.—Professor Balfour, President, in the Chair.

The following Gentleman was elected a Resident Fellow of the Society:—

William J. Elmslie, Esq.

The following Donations to the Society's Library were laid on the table:—

Observations on the Distinctive Characters, Habits, and Reproductive Phenomena of the Amœban Rhizopods, by G. C. Wallich, M.D.—From the Author.

Proceedings of the Royal Horticultural Society, Vol. IV., No. 1.—From the Society.

Journal of Proceedings of Linnean Society, Nos. 22–27.—From the Society.

Transactions of the Royal Scottish Society of Arts, Vol. VI., Part III.—From the Society.

Glossaria Linguarum Brasiliensium, von Dr Carl Fried. Phil. von Martius.—From the Author.

Memorias da Academia Real das Sciencias de Lisboa, 2d classe, Tome II., Part II.—From the Academy.

Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlande und Westphalens, 1862.—From the Society.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Messrs P. Lawson and Son—Fruit of *Corylus rostrata* and *Carya amara* from Montreal.

From Rev. John Baillie, Old Calabar—Native Hunting Net.

From W. Forbes, Esq., of Medwyn.—Cones of *Pinus monticola*.

From Mr William Gorrie, Bangholm—Fruits of *Vaccinium Oxycoccus* var. *macrocarpum* (American cranberry), *Vaccinium Vitis-idæa* (Russian cranberry), *Juglans nigra* (Black walnut), *Juglans cinerea* (butter nut), *Castanea americana* (American chestnut).

The following Communications were read:—

I. *New Researches on Hybridity in Plants.* By M. Ch. Naudin. Translated from the French, and communicated by Mr George M. Lowe.

(This paper will appear in the Transactions for March.)

II. *Letter from* Robert Brown, Esq., *Botanist to the British Columbia Association.* Communicated by Professor Balfour.

Valley of the Ses-haat Indians, Barclay Sound,
Vancouver Island,
Lat. 48° 47′ 28″, Nov. 4, 1863.

Though I will be in Victoria about ten days after this date, when I will write you a full account of my transactions for the last three months, yet the politeness of the master of a trading schooner enables me to save a mail, and inform you that I am still in life and at work. Since I last wrote I have been to Washington Territory, U. S., British Columbia, and I have (first of white men) reached the head of the "great" central lake of Vancouver Island—that *ignis fatuus* of the local geographers of this far western portion of her Majesty's dominions. I have obtained seeds of between one and two hundred species of plants (in almost every case in quantities sufficient to allow of a complete division), including some very pretty and previously unintroduced species of herba-

ceous plants, shrubs, and forest trees. Among the last are some good coniferæ—including *Juniperus*, three species—one, a large tree, *Taxus*, n. sp.: fine lot of the rare *Cupressus nutkanus*, Lamb; *Thuja Craigana*; a large quantity of *Abies Bridgei*, not yet introduced into England; about 100 ounces of the finest seed of *Abies Douglasii*; Pinus, species undescribed; *Abies grandis*, Dougl.; 20 or 30 ounces *Abies Menziesii* (is this *Pinus Sitchensis*, Bognard Veg. Sitch. in the St Petersburg Academy Transactions?) &c., and among non-coniferæ, *Quercus garryana?* *Arbutus Menziesii*, Pursh; *Spiræa*, sp. n.; *Oreodaphne*, sp. n., a fine shrub; and, what I think justly entitles the expedition to the credit which it originally laid claim to—viz., national importance,—about three pounds weight of a fine pasture grass from the Upper Fraser, which survives all winter, and is accounted by the Cariboo muleteers superior in fattening qualities to hay, and certainly much more valuable to them, as the cattle and the mules have nothing else to subsist on during the long bleak winter, when the ground is covered with snow, and hard as iron. I have gathered, and am still gathering, many particulars of its properties from the muleteers and teamsters, which in due time I will submit to you. I believe that it is superior to the much-lauded "Tussac grass" of the Falkland Islands, and might be introduced with great advantage into some of the bleak islands of the Hebrides, or of Orkney and Shetland, where I have known cattle to die off in the winter from want of proper fodder. My attention was originally drawn to this grass by Colonel Moodie, R.E., to whom, therefore, all credit is due; and I believe that I am at liberty to say that he coincides fully in the above statement. You may remember that it was he who introduced the Tussac grass, and obtained a gold medal for his discovery. The great region for coniferæ I have found, since my present summer's travels have terminated, to lie south of this latitude, and to it therefore, with your permission, I shall in future devote more attention. My funds are in a satisfactory condition, and although the stormy winter, now fairly set in, will prevent me doing much more for some months, I am prepared to start in early spring with renewed vigour to a widely different, and what I now believe to be a better region than the one I have explored. I trust that I shall be able to take the field by the 1st of April with advantage to the Association, and with every prospect of much greater success attending my efforts than during the previous six months. I know of some good species of coniferæ which I could not obtain this year, but I am almost certain of next year—such as *Abies Williamsoni* from "The Three Sisters," in the Cascade Mountains, *Abies bracteata*, *Picea nobilis*, and a new species of *Thuja*.

I have had much to contend against this season, but the difficulties are now, I am glad to say, in a great measure over. I now know the country, and what is just as important, the people, so well, that should there be only half the subscribers of the previous year, I will be able to do tolerably well. Many expenses were incurred last year which will not be required again. These are in addition to the sum paid for travelling to this distant part of the world (Kamtschatka is the furthest sea voyage, and that is only a few days' sail from here). Last night I was awoke from my camp-fire sleep by the "long cry" of the same wolf that "howls from Unalaska shore."

On my return to civilisation, I will send my seeds to England by Wells, Fargo, and Company's expresses, in several air and water-tight boxes, addressed to you, "care of the Hudson Bay Company," prepaying the freight. This will be expensive; but the agent here refuses to receive them on any other terms, a standing order having been issued to that effect. I will at the same time send a fuller account of my procedure,

and by later mail a statement of my intromissions will be sent to the treasurer. In order that you may be early advised of the despatch of the seeds, and be ready to make the necessary arrangement with the secretary of the Hudson Bay Company, I will send this and the next letter overland by the pony rider, *via* the Salt Lake City, to St Joseph, in Missouri, and thence *via* New York to Liverpool. It will save nearly three weeks, and I hope will escape the emissaries of President Davis.

I am in good health and strong; rough, ragged, weather-beaten, perhaps a little dirty, and certainly a most unpresentable figure at the meeting where this communication will be read. I am sleeping on a curious Indian blanket, woven from the liber of *Pinus Strobus* (is it the same as the *P. Strobus* of the East?), and to keep the hoar frost off my blanket, there is a mat (clay hulk) of the bark of *Thuja gigantea*. Both will, I hope, at some future day, ornament the museum at the Botanic Garden.

III. *Extracts of Letters received from* Mr William Milne, *Old Calabar.* Communicated by Mr John Sadler.

Creek Town, Old Calabar,
June 29, 1863.

I am fairly settled in the district of Old Calabar, exploring the creeks and corners of this majestic river. Africa is certainly rich in botany and other branches of natural history. Years must roll away before the botany of this vast continent is thoroughly investigated, and that will not be until Christianity is upon a more substantial basis. I will give you one extract from my daily journal to show the superstition which still exists amongst the people in Western Africa. While in the district of Ikorofiong, in passing through a large native town in the Ebebo country, I saw a straggling shrub belonging to Bignoniaceæ. While in the act of pulling down some of the flowers, I was surrounded by some hundreds of men, women, and children, shouting and dancing like so many fiends. At first I was inclined to think they were about to hang me in front of their palaver house or heathen temple. On looking round I could see no way of escape, so I held my ground, determined to have some of the flowers; but they were as determined that I should not get them. At last they put me out of the town. On the following Sunday I accompanied the Rev. Zerub Baillie to several of the plantation villages, where he preaches once a week. We met the Ebebo chief. I wished to shake hands with him, but he would not come near. He said he was afraid of the strange medicine I was making, and told Mr Baillie that I was not to come to his town again.

About a fortnight ago a man told me that if I went into the bush I would be shot: so you see it is not all plain sailing at Calabar. But I have an extensive field before me, and I am determined to make the best of it, in spite of the natives, as it will not do to let them have it all their own way. I will mention a few of the leading characteristics of the vegetation which have come under my own observation.

There are five species of Melastoma, six species of Dracæna, five species of Amomum, and several others belonging to Zingiberaceæ. There are a number of species belonging to Scrophulariaceæ; and amongst them is a Digitalis, which is scattered over all waste ground. Euphorbiaceæ and Cucurbitaceæ are both extensive orders here. Three species of Amaryllis are abundant—one in the river, and the other two spread all over the plantations. Solanaceous plants are numerous: there are two kinds sold in the market as purgatives and for bathing the sides of their faces when they have a discharge from the ears. Anonaceæ is

another extensive order. According to the Rev. Mr Thomson, there are sixteen or eighteen kinds. I have collected a number of Bignoniaceæ and Cinchonaceæ. I have also met with eight or nine species of Convolvulus, but there are more than that. Amongst the Labiatæ is a large species of Salvia, which is used as a medicine. There are three true mints which are used for seasoning; in fact, all this order is made use of as articles of food. A species of Nymphæa is frequent in the inland streams.

I think there are from eighteen to twenty-four distinct Orchids: one fine terrestrial species has a flowering stem 6ft. or 7ft. high. There are two fine species of Strophanthus. One true Verbena and two Clerodendrons are abundant. I have also observed two species of Amaranthus. "Love-lies-bleeding" is one of them, but I am doubtful if this is indigenous, although the natives say so. Both kinds are used as vegetables in Calabar chop. One Pentstemon is found by the margin of a small stream at Ikorofiong, but not plentiful. A Phytolacca and a Polygonum also occur at the same place. I have collected specimens of a Loranthus from trees by the banks of the river. Two species of Lonicera are very common. Leguminous plants are very numerous. Amongst them is a sensitive Mimosa. The poison beans (Physostigma) are often used for deadly purposes. One species is largely cultivated for putting into the streams to poison the fish, and another is sold in the markets for Calabar chop: one kind is very like our scarlet runner. The ripe pods are from 6 to 8 inches long, and the fruit is beautifully spotted. Compositæ are not so numerous as might be expected: however, there is a due proportion. A Tillandsia climbs up the palm trees. There is one fine species of Calophyllum, and a tree belonging to Myrtaceæ; also an Aristolochia, which I think is gigantea. There are five different palms. One large species of Juncus is abundant on the sides of the river at Creek Town; also another smaller species. There are several Cyperaceæ by the river, and amongst the lowland plantations there are a number of Gramineæ sprinkled about. Eighteen varieties of yams and six varieties of Colocasia are cultivated; the flowering stems of the latter, with spathe and spadix, are sold in the markets for putting into Calabar chop. The corms are also boiled, and used by the natives. There are two kinds of Cassava largely cultivated. There is only one true Banana with very small fruit, and eight kinds of plantains, sold in the markets. There is a malvaceous plant cultivated; the fruit is cut up into slices and put into soups. There are also two species of Agaricus sold in the markets. They are said to be very nourishing, and to give a fine flavour to Calabar chop. The larger kind is also put into rum, as it is of an intoxicating nature. Calabar chop is composed of the following ingredients:—Palm oil, yams, mints of all kinds; flowering stems, leaves, and corms of the colocasia; two species of agaricus, the fruit of two leguminous plants, the leaves of two kinds of amaranthus. The rest consists of monkey's flesh, dogs, rats, fish, goats, fowls, parrots, and birds of all kinds; in fact, everything eatable, whether animal or vegetable, is put into this wonderful dish. It is a favourite dish among the natives, and relished by Europeans, only they take nothing but palm oil, fowls, and goats' flesh. I have only seen three species of snakes. There is only one parrot, five species of monkeys, three rats, and three mice, four or five land crabs, and a number of fresh-water fish, some sixty or eighty butterflies, and a host of beetles and other insects. Amongst my collection I find twenty-four different ants. Such is a very brief outline of the botany and natural history around Old Calabar.

Creek Town, July 1, 1863.

I am hard at work exploring one of the finest rivers on the west coast of Africa. As you ascend this noble river, the banks and surrounding

country are one vast amphitheatre of everlasting green. I am delighted with the appearance of the country and its vegetable products. I have got an extensive field before me, and undoubtedly, if all goes well, I will find many a novelty. This great continent is teeming with animal and vegetable life. Even in my room I have got use for an insect net. It is a great pity that the climate is so unhealthy. Fevers are very prevalent. I have had three attacks of fever since I landed upon the African coast. Fortunately I am blessed with a strong constitution, and I get easy over it; but such is not the case with everybody. The bones of many a blooming youth are bleaching beneath the sun at Calabar.

The natives are not such a murderous class, except amongst themselves. For instance, there is not a day passes but they are killing their twin children instantly after birth, and banishing the unfortunate women to what they call twin villages, where they are left to languish out a life of silent sorrow, and are denied all intercourse with the rest of the world. Mrs Goldie, about seven weeks ago, saved two of those little unfortunates. She remained by the poor woman until she was confined, and then at the dead hour of midnight she entered the mission-house with a little boy and a girl rolled in her lap. The mother followed about six o'clock in the morning. They are all under the protection of the Rev. Mr Goldie. About a month ago the King of Creek Town had a sister whose daughter died of consumption. She sent for a number of her slaves, to give them poison bean. Three women died, three more escaped by vomiting, and one girl took refuge in the mission-house, under Mr Goldie, where she is now attending the school. These poor people were to be servants to her daughter in the future world. As soon as the rainy season is over, I am going to the Qua Mountains, and that will be the time for plants of all kinds. My collections will be upon a grand scale by-and-by. Only the other day I found a splendid climbing lily; it is a true turn-cap lily, and will form a grand show upon the rafters of any stove.

IV. *Extract from Letter from* Dr Meredith, *Georgetown, Demerara, dated* 21*st November* 1863, *to* Professor Balfour.

Dr Meredith says:—I daresay you know the topography of the large streams in this neighbourhood. The Essequibo is the largest, and lies nearly north and south. The Euyuni, nearly east and west, and the Massaruni, lies between the two, and runs nearly north-west. The two last meet about four miles above the penal settlement, and their joint current unites with the Essequibo about five miles below the penal settlement. The penal settlement is on the west or left bank of the river. The country is nearly a dead level, and at irregular intervals creeks open into the rivers on both sides, and are often navigable for boats. Their mouths are usually entirely hid by foliage. But the Indians know the right gaps as perfectly as did the old smugglers know the caves and holes on the Scotch coasts. I have often been in these creeks for miles, going with two or three hands in a small canoe—dodging under branches, hauling over a prostrate log, and charging through leafy shrubs, lying down nearly flat in the canoe all the time. It was very seldom we came to a place we could see the sky above—such is the dense nature of the bush. In many parts there is never more than dim twilight, and in the rainy season when the sky is dark or cloudy it is a perfect midnight even at mid-day. Never is there a breeze experienced. We have only a rustling sough some 80 or 100 feet over head. I have often been thinking that the usual description given of the luxuriance of the vegetation during the coal epoch might be applied with great effect to the vast

forest of Guiana. The most remarkable feature of the bush is perhaps the immense quantity of parasites, but particularly epiphytes, with their long descending cord-like roots of all lengths, up to 90 or 100 feet, and not thicker than an ordinary writing quill. They are usually very tough. In one of our excursions my companion and I set to work to pull at one of these. We could not see from what height it came, nor to what kind of plant it was attached; however, we pulled, and with great success, as it happened, but we brought a tremendous shower of water upon our heads, as well as a host of black ants, which teased us dreadfully for a while by getting under our clothing. We had dislodged one of the air-plants belonging to the pine-apple order, and the ants' nest must have been attached to it. The root was, I think, about thirty feet long. The Indians always use them as *cables* for mooring their canoes. In April last a friend and I started off to see the *Victoria regia* up the Essequibo river. We were away nearly a week. It was a delightful excursion. The scenery all along the river was really magnificent—thoroughly unlike anything I ever saw at home. The clearness of the atmosphere, the rank luxuriancy of the bush all along the river, mirrored in its gently flowing stream, gave to the whole a picture of exquisite beauty. The habitat of the lily in this district is a lake on an island in the river about the 6th parallel of N. lat.; where Schomburgk first saw it was up above Berbice on the Corentyn river. This lake (Essequibo) was surrounded by dense vegetation, which rendered it very difficult to approach. It was covered with the lily in all stages of its existence—the large white flower, the beautiful crimson edges of the young leaf changing into green as it grows. When it has attained its full dimensions the leaf begins to wither and die at its circumference; but as fast as it decays its place is taken up by a new one. Thus the great *struggle* goes on. I managed to get a good view of the place by climbing along the trunk of a tree which partly overhung the lake. A drizzling rain had been falling for an hour or so before we arrived at the lake; but just as I had ascended my perch on the tree it ceased, and a gleam of sunshine fell on the water, with a slight breeze, causing the vast flotilla to roll gracefully to leeward, throwing out various shades of colours. It was certainly the prettiest water scene I ever witnessed. A day or two afterwards I saw the Indians poisoning a small lake with the "Hiari" bush rope. I entered into the sport with right goodwill. The Indians cut the "Hiari" into pieces of about two feet long, then proceed into the water and beat out the juice of it as a blacksmith beats hot iron with a hammer. The fish begin to show signs of uneasiness, very soon get regularly intoxicated, and often jump clean out upon the dry land, unable to bear the poisoned water any longer. When they were in this state of helplessness the Indians, as well as my friend and I, with some half a dozen negroes, speared or caught them with nets by the dozen. They were most extraordinary looking fish. Some of them bite like dogs, and have very sharp teeth. One of the Indians got a severe wound from one of them. The most ferocious fish I have met here is what the Indians call the "piari;" it cuts as clean as a knife. The quantity of fish in these rivers is perfectly surprising, and if I am not mistaken, their natural history has yet to be commenced.

We spent a day at an Indian settlement, where the inhabitants were most scrupulous in painting themselves with red paint all over, but considered themselves amply clothed by wearing a lappet about six inches square. I asked one young man who had painted his body various colours like the belts on a tiger, and had his head dressed out with Macaw feathers, why he did it? His answer was, "because it looked pretty, and the women liked it." I wonder what an Eastern satrap would say if he was transported into the midst of an Indian village, and saw the differ-

ence of clothing from that in his own country, where a woman dare hardly show the tips of her fingers. We spent a few nights in the bush, swinging hammocks between trees with a sail stretched over them. We were often disturbed by the noise of the "howling monkeys." They make a most awful and dismal noise. They can be heard several miles away. I see the London Zoological Gardens obtained a pair of them the other day. I have been very much interested in trying to make out the history of the enormous boulders which are to be met with about the penal settlement and above. There is no rock like them within hundreds of miles, and the ground on which they rest is pure alluvial soil. The ground of the penal settlement is covered by a collection of them, forming what, I suppose, would be called a moraine. How came these huge blocks down here—could it be by means of glaciers? The gold discovered up the Euyuni, which is now beginning to excite deserved attention, is found chiefly in boulders of this description. The parent rock is in some of the mountains in the interior—but where, no one knows. There is ample room for explorers in this part of the world. I have not been up to the gold district, although I once tried it. Our boat proved too heavy for hauling over the falls. Descending these rapids is most exciting work. We came down almost at railway-train speed. We have always to get Indians to steer, two in each boat.

V. *Notice of Mosses found near Blair-Athole, Perthshire.* By Miss M'Inroy, of Lude. Communicated by Mr John Sadler.

Andreæa alpina
rupestris
Sphagnum cymbifolium
compactum
rubellum
acutifolium
fimbriatum
contortum
Phascum cuspidatum
subulatum
Gymnostomum tenue
rupestre
curvirostrum
Weissia controversa
verticillata
Rhabdoweissia fugax
Seligeria pusilla
recurvata
tristicha
Anodus Donianus
Blindia acuta
Cynodontium Bruntoni
Dicranum pellucidum
squarrosum
crispum
varium
heteromallum
falcatum
scoparium
majus
Leucobryum glaucum
Ceratodon purpureus
Campylopus torfaceus
flexuosus
Pottia truncata
Anacalypta lanceolata
Distichium capillaceum
Didymodon rubellus
Trichostomum rigidulum
Tortula rigida
unguiculata
fallax
tortuosa
convoluta
muralis
subulata
lævipila
ruralis
Mülleri
Encalypta vulgaris
ciliata
rhabdocarpa
streptocarpa
Hedwigia ciliata
Schistidium apocarpum
Grimmia pulvinata
patens
Donniana
Racomitrium aciculare
fasciculare
heterostichum
lanuginosum

Racomitrium canescens
Ptychomitrium pollyphyllum
Orthotrichum cupulatum
anomalum
tenellum
stramineum
affine
rupestre
leiocarpum
pulchellum
crispum
Bruchii
Drummondii
Tetraphis pellucida
Atrichum undulatum
Pogonatum nanum
aloides
urnigerum
Polytrichum commune
juniperinum
piliferum
Aulacomnion palustre
Leptobryum pyriforme
Bryum crudum
carneum
Wahlenbergii
pseudotriquetrum
pallens
capillare
sanguineum
atropurpureum
julaceum
argenteum
Zierii
roseum
Mnium cuspidatum
rostratum
serratum
hornum
undulatum
punctatum
Amblyodon dealbatus
Funaria hygrometrica
Physcomitrium ericetorum
pyriforme
Bartramia fontana
pomiformis
Oëderi
ithyphylla
arcuata
Splachnum ampullaceum
Tetraplodon mnioides
Fissidens viridulus *var.* pusillus
bryoides
adiantoides
taxifolius
Leucodon securoides
Antitrichia curtipendula
Anomodon viticulosus
Pteragonium filiforme
Isothecium alopecurum
myurum
myosuroides
Climacium dendroides
Leckea sericea
rufescens
Hypnum salebrosum
lutescens
plumosum
populeum
velutinum
rutabulum
rivulare
piliferum
prælongum
Swartzii
Teesdalii
striatum
ruscifolium
confertum
tenellum
atro-virens
serpens
stellatum
heteropterum
palustre
cuspidatum
Schreberi
purum
tamariscinum
splendens
brevirostre
triquetrum
loreum
squarrosum
fluitans
revolvens
filicinum
commutatum
uncinatum
molluscum
cupressiforme
scorpioides
incurvatum
pulchellum
undulatum
sylvaticum
denticulatum
Omalia trichomanoides
Neckera complanata
crispa
Hookeria lucens
Fontinalis antipyretica

VI. ***Principal Plants of the Sutlej Valley* with Hill, Botanical, and English Names; together with approximate Elevations, and Remarks.*** By Dr Hugh F. C. Cleghorn.

Kelu (*Cedrus deodara*), Deodar or Himalayan cedar; 6000 to 8000 ft.—Properly *dewa-daru*, god-timber, probably identical with the cedar of Lebanon.

Kail (*Pinus excelsa*), Lofty pine; 7000 to 11,000 ft.

Chíl or Sulla (*P. longifolia*), Long leaved fir; 1500 to 7000 ft.—The resin is used as a dressing for sores.

Neoza (*P. gerardiana*), Edible pine; 5000 to 10,500 ft.—Wood not used.

Rai (*Abies smithiana*), Himalayan spruce; 9000 to 11,000 ft.—The wood of this is much inferior to the other pines.

Pindrow or Tos (*Picea webbiana*), Webbian pine or silver fir; 8000 to 11,000 ft.—The wood of this is much inferior to the other pines.

Deodar (*Cupressus torulosa*), Cypress; 6000 to 8000 ft—Wood useful, but trees scarce, not felled.

Lewar or Shur (*Juniperus excelsa*), Pencil cedar; 9000 to 12,000 ft.—Yields an excellent, light odoriferous wood.

Pama or Talu (*J. squamosa*), Creeping juniper; 12,000 to 13,000 ft.—Used as firewood in crossing the high passes.

Tuna (*Taxus baccata*), Yew; 9000 to 10,500 ft.—Wood used for bows and jampan poles.

Paprung or Shamshad (*Buxus sempervirens*), Box; 6000 ft.—Wood used for plugs of rifle bullets, also for wood engraving.

Bán (*Quercus incana*), Hoary oak; 5000 to 8000 ft.—The principal firewood in the hill stations.

Bré (*Q. ilex*), Evergreen oak; 8000 ft.

Mohru (*Q. dilatata*); 6000 to 9000 ft.—Yields an excellent heavy wood.

Kursoo (*Q. semicarpifolia*), Alpine oak; 9000 to 12,000 ft.—A magnificent tree-timber, much esteemed by the natives.

Quercus floribunda; 9000 ft.

Paharee-Peepul (*Populus ciliata*), Poplar; 6000 ft.—Wood soft, coma of seeds, a paper stuff.

Populus alba, White poplar.

Akrot (*Juglans regia*), Walnut; 7000 to 9000 ft.—Wood used for gun-stocks and furniture.

Kunch (*Alnus obtusifolia*), Alder; 4000 to 5000 ft.—The charcoal employed in iron smelting.

Knor (*Pavia indica*), Himalayan horse-chestnut; 5000 to 8000 ft.—Seeds eaten in time of scarcity.

Bras (*Rhododendron arboreum*), Rhododendron; 6700 to 8000 ft.—Flowers made into jelly—subacid.

Bhoj-putra (*Betula bhoj-putra*), Birch; 10,000 to 13,000 ft.—Bark used for writing on, and covering umbrellas.

Bankimu (*Corylus lacera*), Hazel; 8000 ft.—Wood light, compact.

Acer lævigatum, Polished maple; 9000 ft.—The knots are hollowed out, and used as drinking cups.

Kow or Wee (*Olea ferruginea*), Olive;† 3500 to 5000 ft.—Wood used for combs; it is much like box.

Cham Khuruk (*Carpinus viminea*), Hornbeam; 5500 ft.—Wood esteemed by carpenters.

* This list is a tolerably complete summary of the useful plants found between Rampur and Sungnam.

† This resembles closely the European olive.

Eliyun or Ayar (*Andromeda ovalifolia*), Andromeda; 7000 ft.—Wood used for charcoal.

Rous (*Cotoneaster bacillaris*), Himalayan mountain ash; 8000 to 10,000 ft.—Wood used for walking sticks.

Thurnel (*Benthamia fragifera*); 6000 ft.—The fruit used as a preserve.

Behul (*Grewia oppositifolia*); 5000 ft.—The branches are periodically cut in winter time as provender for the cattle.

Dhamnoo (*G. elastica*); 4000 ft.—The branches are periodically cut in winter time as provender for the cattle.

Toong (*Rhus parviflora*), Sumach; 5000 ft.—Wood hard, yellow.

Kakkar (*R. acuminata*), Sumach; 5000 ft.—Wood prized for furniture.

Titri (*R. semialata*), Sumach; 5000 ft.—Wood prized for furniture.

Tuna (*Cedrela toona*), Common toon; 6000 ft—Much used for furniture.

Kagshi (*Cornus macrophylla*), Dogwood; 7000 ft.—Charcoal, employed in the manufacture of gunpowder.

Fraxinus xanthoxyloides, Crab-ash; 7000 ft.—Makes good walking sticks, hefts, and handles.

Gengaru (*Cratægus crenulata*), White thorn; 3000 to 7000 ft.—Used for staves, &c.

FRUITS.*

Juldaru (*Armeniaca vulgaris*)), Apricot; 7000 to 13,000 ft.—The apricot does not ripen above Shalkar (J. D. Cunningham); it occurs up to 13,000 ft. It is a common article of food, and a source of wealth.

Aru (*Amygdalus persica*); Peach.—It has little flavour.

Jamuna (*Cerasus cornuta*) Bird cherry; 7000 to 10,000 ft.—Simla.

Paddam (*C. puddum*), Cherry; 3000 to 7000 ft.

Palu (*Pyrus malus*), Apple.—The apples in Kunawar want flavour compared with those in Kashmir.

Mehul (*P. variolosa*), Wild pear; 3000 to 7000 ft.—When rotten, the fruit becomes sweet.

Trummel (*Ficus macrophylla*), Wild fig; 5000 ft.—Sold in bazaar, Simla; flavour pleasant.

Akrot (*Juglans regia*), Walnut; 7000 to 9000 ft.—This fruit ripens well at Pangi, but not much higher.

Ribes nubicola, Currant; 11,000 ft.—Several varieties occur, but the fruit without flavour.

R. glaciale, Currant; 11,000 ft.—Several varieties occur, but the fruit without flavour.

R. grossularia, Gooseberry;† 10,000 ft.—Asrung valley.

Ungoor (*Vitis vinifera*), Vine; 7000 to 9000 ft.—The grape is an uncertain crop, and this year (1862) the excess of rain was particularly unfavourable.

Ré or Neoza (*Pinus gerardiana*), Edible pine; 7000 to 10,000 ft.—The neoza or chilgoza pine is first seen on the Miru ridge, and above Chini becomes a principal tree of the forest. The seeds are collected and stored for winter use, being a regular article of food—the price asked in spring was two annas per seer.

Fenduk (*Corylus lacera*), Hazel; 8000 ft.—The nuts are sold in Simla.

Kaiphul (*Myrica sapida*), Box myrtle; 4000 to 6000 ft.—Fruit used for making sherbet.

Unsri (*Rubus flavus*), Bramble; 5000 to 7000 ft.—Fruit used for preserves.

* The *plantain* is last seen below Kotgurh, and the *mango* near Rampur.

† This appears to be identical with *R. Himalense*, Royle, fig. in Jacq. ic., t. 77.

Fragaria vesca, Strawberry; 7000 ft.—Common, but produces a small, tasteless fruit.

Toothree (*Morus parvifolia*), Mulberry; 4000 to 7000 ft.—Cultivated, foliage prized for cattle.

GRAINS.*

Kunuk, or Gehun (*Triticum sativum*, two varieties), Wheat, red and white; 13,000 ft., highest limit, 15,000 ft.—The bearded and awnless wheat occur; *Kunuk* denotes the flour, not the grain.

Ujou (*Hordeum cœleste*), barley; highest limit, 15,000 ft.—The beardless variety is most esteemed. Barley ripens in the end of May, several weeks before wheat.

Jou (*H. hexastichon*), common barley; highest limit, 15,000 ft.—Much cultivated.

China (*Panicum miliaceum*), Millet; 6000 to 9000 ft.—In the middle regions it is one of the chief crops.

Kora or Koda (*Paspalum scrobiculatum*)—This is an inferior grain, only used by the poorest classes.

Jungeru (*Pencillaria spicata*), Spiked millet; 5000 ft.—Confined to the lower valleys.

Ogal (*Fagopyrum emarginatum*), Buckwheat; 13,000 ft.—At high elevations cultivated to a great extent.

Paphra (*F. esculentum*), Buckwheat; 13,000 ft. At high elevations cultivated to a great extent.

Mundwa (*Eleusine coracana*), Ragi; 5000 ft.—Perhaps the most productive of all Indian cereals.

Bathu (*Amaranthus frumentaceus*), Amaranth; 7000 ft.—This food plant is cultivated on the Neilgherries.

Jowar (*Sorghum vulgare*), Great millet; 6000 ft.—Grown only in the valleys.

Bhatwa (*Chenopodium vulgare*), Goosefoot; 7000 ft.—Entirely a rain crop, grows to six feet high, seeds considered nourishing.

PULSES.

Masúri (*Ervum hirsutum*), Lentil; 5000 ft.—In corn fields.

Mash (*Phaseolus radiatus*), Black pea; 6000 ft.—The seeds are both black and green.

Urud (*P. max*), Black gram; 6000 ft.—The seeds are both black and green.

Batana (*Pisum sativum*), Field pea; 8000 to 14,000 ft.—Cultivated in Kunawar and Spiti.

Bakla (*Faba vulgaris*), Common bean; 8000 to 14,000 ft.—Cultivated in Kunawar and Spiti.

Bhut (*Soja hispida*), Soy bean; 6000 ft.—I also saw one patch of this kind of pulse.

ECONOMIC PLANTS.

Bhang (*Cannabis indica*), Indian hemp; 3000 to 7000 ft.—Yields *churrus* and Himalayan hemp.

Atees (*Aconitum heterophyllum*), Atees plant; 8000 to 13,000 ft.—The roots are much employed as a tonic and febrifuge.

Tilia kachang (*A. napellus*), Wolfsbane; 10,000 to 15,000 ft.—The roots are used for destroying wild animals.

Moura bikh (*A. ferox*), Poisonous aconite; 10,000 to 14,000 ft.—The roots are used for destroying wild animals.

* Rice is not observed above 6000 ft.

Burmot (*Thalictrum foliolosum*), Meadow rue; 5000 to 8000 ft.—Root used as a febrifuge.

Kurrooa (*Picrorhiza kurrooa*), Bitter root; 11,000 ft. Root used as a febrifage. Exported to the plains.

Chumresh or Simbur (*Rhododendron campanulatum*), Alpine rhododendron; 10,000 to 14,000 ft.—Leaves used as snuff, known as *kasmiri* puttay.

Talsur (*R. lepidotum*), Alpine rhododendron; 10,000 to 14,000 ft.—Leaves highly stimulant.

Kanta (*Meconopsis aculeata*), Prickly poppy; 10,000 to 12,000 ft.—Flowers blue-purple, showy.

Jeku (*Daphne papyracea*), Paper shrub; 5000 to 8000 ft.—Paper prepared from the bark.

Koo (*Celtis .eriocarpa*), Nettle tree; 6000 ft.—Bark used for making shoes.

Soorch (*Hippophaœ salicifolia*), Buckthorn; 10,000 ft.—Berries form a good preserve mixed with sugar.

Lodh (*Symplocos paniculata*), Symplocos; 7000 to 9000 ft.—Used in dyeing with madder.

Bhekul (*Prinsepia utilis*), Prinsepia; 4000 to 8000 ft.—Used for hedges; yields an oil.

Moorub (*Desmodium*); 7000 ft.—Bark is used as a paper stuff.

Rumex acetosa, Sorrel; 6000 to 8000 ft.—Widely distributed.

Oxyria reniformis, Mountain sorrel; 6000 to 8000 ft.—Used as a native remedy.

Kafi (*Chaptalia gossypina*), Shepherd's tinder; 7000 to 9000 ft.—The tomentum on the under surface of the leaves is employed by the hill people as tinder.

Kusbul (*Aplotaxis fastuosa*), Shepherd's tinder; 7000 to 9000 ft.—The tomentum on the under surface of the leaves is employed by the hill people as tinder.

Tanacetum tenuifolium, Tansy; 10,000 ft.—Odour pleasant, useful for flavouring puddings.

Karonda (*Carissa edulis*); 3000 to 5000 ft.—Fruit made into jelly.

Gehai (*Elœagnus conferta*), Oleaster.—Fruit edible; acidulous.

Nepari (*Delphinium brunonianum*), Musk plant; 14,000 ft.—Smells powerfully of musk.

Chitra (*Berberis lycium*), Berberry; 3000 to 9000 ft.—The extract "Rasut," is prepared from the root, and a yellow dye.

Berberis aristata, Berberry; 6000 to 10,000 ft.—The extract "Resut" is prepared from the root, and a yellow dye.

Indigofera pulchella, Wild indigo; 7000 ft.—Rocky hills, abundant.

Capparis obovata, Caper; 3000 to 5000 ft.—Fruit pickled.

Nigala (*Arundinaria utilis*), Hill bamboo; 9000 ft.—Used for wicker work, and for lining the roof of houses.

Bichu (*Urtica heterophylla*), Neilgherry nettle; 4000 to 7000 ft.—Yields a valuable fibre.

Puya (*Bohineria nivea*), Rheea; 4000 to 6000 ft.—Furnishes a textile fibre of great value.

Siharu (*B. salicifolia*); 6000 ft.—Used for making ropes.

Kurroo (*Gentiana kurroo, G. Kashmirica*), Himalayan gentian; 10,000 ft. —Near the eternal snows.

Cherayita (*Ophelia paniculata, O. purpurascens, O. speciosa*), Chiretta; 7000 to 9000 ft.—These annual plants supply the chief portion of the bitter root exported to the plains.

Piperi (*Tulipa stellata*), Tulip; 4000 to 6000 ft.—Bulbs edible.

Leontodon taraxacum, Dandelion; 6000 to 10,000 ft.—Yields the officinal extract.

Raee (*Sinapis glauca*), Mustard; up to 11,000 ft.—Much cultivated. Several species of *Sinapis* are grown as salads and condiments.

Jira (*Cuminum cyminum*), Cumin of Scripture; 7000 to 9000 ft.—Abundant in pasture; seed exported to the plains.

NOTE.—An admirable description of the configuration of the hills, and of the botanical features of the valley of the Sutlej, is contained in Thomson's "Travels in the Western Himalaya." In determining the native names of the plants of Bussahir, much assistance may be derived from consulting the copious index of Royle's "Illustrations of the Botany of the Himalaya," and Jameson's "Report of the Botanical Gardens, North West Provinces, 1855."

This list of plants may be found useful by visitors to Kunawar, and by the engineers of the Hindostan and Thibet road, who have many opportunities of making additions and corrections.

Useful Trees and Shrubs of Kûllû and Kangra.

CONIFERS.

Kelu (*Cedrus deodara*), Deodar or Himalayan cedar.—Grows on north slope of Dhaola Dhar, and in Kûllû.

Kail (*Pinus excelsa*), Lofty pine.—In Kûllû, not in Kangra.

Chil or Chir (*P. longifolia*), Long leaved pine.—Grows luxuriantly on north slopes, timber best at 4000 to 5000 feet.

Neoza (*P. gerardiana*), Gerard's or edible pine.—A few trees across the Dhaola Dhar, near Ulassa on the Ravi.

Tôs (*Picea webbiana*), Webb's pine or silver fir.—The wood is not much valued, shingles are laid on the roof of houses.

Rai (*Abies smithiana*), Himalayan spruce.—The wood is not much valued, shingles are laid on the roof of houses. The rai is often 100 ft. high, and 5 ft. in diameter.

Deodara (*Cupressus torulosa*), Twisted cypress.—At the head of the Parbati (Longden).

Bramhi or Rakhal (*Taxus baccata*), Common yew.—In Kûllû, very scarce.

Leuri or Suri (*Juniperus excelsa*), Pencil cedar.—On the crest of Dhaola Dhar and in Lahûl.

OAKS.

Bahn (*Quercus incana*), Common Himalayan oak.—The English residents at Dharmsala use this timber for beams and rafters.

Mohrû (*Q. dilatata*).

Kharsû (*Q. semicarpifolia*), Alpine oak.—Seldom grows belows 8000 feet, and ascends above the range of pines.

Baloot, (*Q. ilex*), Evergreen oak.—Very rare, becomes common at Marri and in the Trans-Indus Hills.

Chinar (*Platanus orientalis*), Oriental plane.—Of giant size and great beauty in Chamba.

Mandal (*Acer caudatum*), Maple.—Wood not esteemed by natives.

Maral (*Ulmus campestris*,) Small-leaved elm.—Many fine trees of the *murali* or *mehun* in the upper parts of Kûllû, 30 ft. in girth, wood esteemed.

Himbureh (*U. erosa*), Large-leaved elm.—Many fine trees of the *murali* or *mehun* in the upper parts of Kûllû, 30 ft. in girth; wood not esteemed.

Akhrôt (*Juglans regia*), Walnut.—Most valuable for the fruit as well as the wood, which from old trees is dark-coloured and handsome.

Goonh Knór, or Jooah (*Pavia indica*), Indian horse-chestnut.—A picturesque tree; wood sometimes used for furniture, very abundant in Kûllû, at 6000 to 8000 ft.

Dimri (*Cedrela serrata*), Hill toon.—Recognised by its long racemes of flowers.

Kunch or Koish (*Alnus nepalensis*), Himalayan alder.—Bark used in tanning, wood for gunpowder charcoal.

Bhurj or bhojaputra (*Betula bhoj-putra*), Paper birch.—Sanscrit name of the delicate bark used as paper, for covering umbrellas and lining hookahs, &c.

Jhanji (*Corylus colurna*), Hazel.—A good sized tree, called *sharoli* on the Par bati.

Shamshad (*Buxus sempervirens*), Box tree.—Abundant near Manikaran, wood in demand for engraving, and plugs of rifle balls.

Kanoch, or Tum (*Fraxinus xanthoxyloides*), Crab ash.—Very small; occasionally jampan poles are made of it.

Sannan (*F. floribunda*), Large ash.—This was introduced by Mr Macleod from Pangi to Dharmsalla. In toughness resembles English ash.

Halêo (*Cornus macrophylla*), Dogwood.

Rirhi (*Viburnum*), Elder.—There are several species.

Kurun or Tut (*Morus parvifolia*), Mulberry.—Wood highly esteemed.

Karrak (*Celtis orientalis*), Nettle tree.—Planted in avenues, Kûllû.

Kahû (*Olea cuspidata*), Olive tree.—Valley of Parbati; varies much in the shape of its leaves, and appears to be *O. europæa*.

Ekulbîr (*Datisca cannabina*).—Root exported to Amritsir as a dye-stuff.

Ringal or Nigala (*Arundinaria utilis*), Hill bamboo.—Shepherds' pipes, baskets, and mats are made of it.

Rouns (*Cotoneaster bacillaris*), Indian mountain ash.—The *alpenstocks* of travellers are made of this wood.

Eliyun (*Andromeda ovalifolia*), Common andromeda.—Leaves injurious to sheep and goats.

Bras (*Rhododendron arboreum*), Common rhododendron.—Tree gives posts 6 in. in diameter, wood brown.

R. campanulatum.

Bré or Kathi (*Desmodium*).—Bark used for paper-making in the jail at Dharmsalla; the plant is very abundant.

FRUITS AND ESCULENT ROOTS OF KULLU AND KANGRA.

Aru (*Amygdalus persica*), Peach.—In gardens thrives vigorously and yields fine fruit.

Mundla aru (*A. persica*, var), Nectarine.—In gardens thrives vigorously and yields fine fruit.

Juldaru (*Armeniaca vulgaris*), Himalayan apricot.—Fruit a staple produce in Kûllû, and common article of food; they are small and firm fleshed, so that they dry well.

Aru bokhara (*Prunus domestica*), Garden plum.—Several varieties of plum, damson, and greengage are cultivated at Holta plantation. The seeds are freely distributed to all applicants.

Alûcha (*Prunus* var.), Himalayan greengage.—Several varieties of plum, damson, and greengage are cultivated at Holta plantation. The seeds are freely distributed to all applicants.

Paddam (*Cerasus puddum*), Common bird-cherry.—Occurs as far as the Indus; a sacred tree among the Hindoos.
Gilas (*C. puddum*, var), Kashmir cherry.—In gardens.
Aru ballu (*C. puddum*, var), Kabul cherry.—In gardens.
Jamun (*C. cornuta*), Himalayan bird cherry.—Grows to a large size, wood esteemed.
Seb or Palu (*Pyrus malus*), Apple.—The apples want flavour compared with those of Kashmir.
Nas pati (*P. communis*), Pear.
Mehal or Kainth (*P. variolosa*), Wild pear.—Yields a valuable wood, brown, hard, fine grained.
Bun-Mehal (*P. baccata*), Crab apple.
Bhee (*Cydonia vulgaris*), Quince.—In great abundance at Nuggur, fruit used for preserves.
Mitha-tendû (*Diospyros tomentosa*).—Two large trees at Jagatsukh bungalow. Fruit edible.
Eriobotrya japonica, Loquat.—This Chinese tree gives well-developed fruit of good flavour.
Rubus flavus, Yellow raspberry.—A very pleasant fruit, Kûllû.
Akhi (*R. purpureus*), Himalayan raspberry.
Fragaria vesca, Strawberry.—Wild strawberries common, but produce little fruit.
Chukri (*Rheum emodi*).—Common rhubarb, (*R. Moorcroftianum*), Small stalked rhubarb.—The *Emodi* is less active as a purgative, and more spongy in texture.
Sural (*Pueraria tuberosa*).—Tubers exported to the plains.
Darim (*Punica granatum*), Pomegranate.—Seeds and rind medicinal.

TREES OF THE LOWER HILLS.

Tun* (*Cedrela toona*), Toon tree.—Wood of a red colour, esteemed for furniture, very durable.
Champa (*Michelia champaca*), Champa tree.—Only known as a cultivated tree.
Sissu or Tali (*Dalbergia sissu*), Sissoo tree.—This valuable tree does not thrive so well as in Goojerat and Jhelum
Sál or Sahkut† (*Shorea robusta*), Saul tree.
Kakur (*Rhus acuminata*), Sumach tree.—This and the following species (Tung) yield beautiful wood; the native name "*kakur singhi*," is from the long curved excrescences.
Tung (*R. parviflora*), Sumach tree.
Behera (*Terminalia belerica*), Beleric myrobalan tree.
Hur (*T. chebula*), Chebulic myrobalan tree.—Valuable tree, the fruit yields a dye and medicine.
Arjun (*T. glabra*).—Timber used for railway sleepers.
Tendu (*Diospyros*), Hill ebony.—The heart wood is generally small.
Mowah (*Bassia latifolia*), Mowah tree.—The seeds yield a fatty oil, and the flower a spirituous liquor.
Tejbul (*Xanthoxylon hostile*).—The aromatic fruit is used as a condiment.
Dhamûn (*Grewia elastica*).—Valued for the elasticity of the wood.

* The Jaswan Dûn was once famous for toon wood, but scarcely a tree is left. I have urged the Zemindars and English settlers to plant it along the banks of water-courses in Kangra Valley.

† There is a small clump of sal trees in the eastern portion of Kangra Valley, near Sujanpur-Tira; a few also occur near Rajpura in Hoshiarpur, which is the western limit of its growth.

Phalsa (*Grewia asiatica*).—Yields a pleasant sub-acid fruit.
Behul (*G. oppositifolia*).—Bark employed for making ropes.
Timbul or Tremul (*Ficus macrophylla*), Broad-leaved fig.—Fruit edible, sold in the bazaars.
Barna (*Cratæva religiosa*).
Kunear (*Cassia fistula*).—Fruit collected for sale.
Kheir (*Acacia catechu*), Catechu tree.*
Sirissa (*A. elata*), Doon Siriss tree.—Confined to the outer hills, bordering on the plains.
Bér (*Zizyhus jujuba*), Bér tree.—Wood used for clogs and saddle-trees.
Jamún (*Eugenia jambolana*).—A large tree, fruit edible, wood useful.
Kuddum (*Nauclea cordifolia*).—Wood yellow; decays when exposed to wet.
Kamela (*Rottlera tinctoria*).—Up to 3000 feet; the dye is sold for 18 rupees per maund.
Nim (*Azadirachta indica*), Neem tree.—Planted. Very scarce.
Bél (*Ægle marmelos*), Bél tree.—In Kangra valley; fruit collected for medicinal use.
Pahari Erind (*Jatropha curcas*), Purging nut.—Along the base of the mountains.
Dhái (*Grislea tomentosa*).—Flowers employed to dye red.
Khajúr (*Phœnix sylvestris*), Wild date.—Bank of Beas above Mandi.
Gundéhra (*Nerium odorum*), Oleander.—Root poisonous.
Keor (*Holarhena antidysenterica*).—Bark an astringent medicine.
Chá (*Thea viridis*), Tea plant.—Very extensively cultivated in Kangra Valley and Kûllû.
Kutchnar (*Bauhinia variegata*).
Maloo (*B. vahlii*).—Leaves used for packing, bark for making rope.
Aonla (*Emblica officinalis*).—Wood used for framework of wells, fruit preserved as a pickle, bark astringent.

VII. The following letter from Henry Stephens, Esq., to Professor Balfour, was read:—In one of the hinds' houses at Arthurstone, near Meigle, in Strathmore, belonging to Mr Kerr, it was suspected that something was wrong under the wooden floor of the ben end, as whenever the wife washed the floor the water became of a red colour, and latterly a fungus intruded itself amongst the clothes of a fixed bed. It was resolved to take up the floor and examine into the matter, when the extraordinary phenomenon presented itself of a fungoid substance stretching from joist

* Major Madden describes the process of manufacturing catechu (*Kuth*) in the Turaee, *vide* "Jour. As. Soc.," June 1848, p. 565. Dr Hooker also, *vide* "Him. Journals," I. p. 52.

At Dharmsalla, there is a station and soldiers' garden, and an *arboretum* belonging to Mr D. F. Macleod, C.S., well worthy of a visit, containing many introduced Himalayan trees of great interest. Box, ash, and various conifers, as well as many European fruit trees adapted to this hill station; it is perhaps the only collection of indigenous alpine trees in the Punjab. At Amb, there is an old Mahomedan garden, containing gigantic specimens of toon, champa, *Artocarpus integrifolia*, *Mimusopse lengi*, *Cupressus sempervirens*, and *Platanus orientalis*. At Holta plantation, there is a large stock of *Stillingia sebifera*, the tallow tree of China, *Elæococca vernicia*, the varnish tree of Japan, and other economic plants. Tea culture has flourished even beyond Dr Jameson's expectations, and has extended beyond Kangra Valley into Mandi and Kûllû. The culture seems to be limited only by the amount of available land.

to joist immediately under the floor like a sheet of half-bleached linen, dry above, but having drops of water suspended from its under side. Both the joists and under side of the flooring deals were rotten. The joists were only two or three inches above the ground, the surface of which seemed covered with a dust like brown rappee. The fungus seems to have penetrated through the joists of the wall between this and the adjoining cottage, and no doubt its floor will be found to be in the same state as this one when it is examined. I was present at the taking up of the floor, and thought of bringing a specimen with me to show to you. I presume that the fungus has been generated by the damp and confined state of the space under the floor; and in order to prevent a recurrence of the evil, I advised that the earth be dug out as deep as the foundation of the house; that broken stones be put in as deep as to come near the under side of the new joists; that the part of the partition wall between the cottages under the floor be pointed with mortar and plastered; that a drain be dug along the back wall of the cottages, as low as the foundation, and filled with broken stones; and that ventilating holes, covered with perforated zinc, be made through the front and back walls, lower than the floor. It would be obliging if you can tell me whether you know this fungoid substance, and to give me your opinion whether you think the means I have suggested will prevent a recurrence of the evil for the future.

Professor Balfour stated that the plant was *Merculius lacrymans*, or the Dry-rot fungus, and that Mr Stephen's directions were most judicious.

Mr P. K. Vartan, medical missionary, Nazareth, sent specimens of *Momordica Characias*. The colour of the fruit when ripe is orange-yellow. After it is ripe it splits. The plant is a climber, growing to the height of eight or ten feet. The ripe fruit, deprived of its seeds, is immersed in olive oil, and used as an emollient application to wounds and painful sores.

Professor Syme presented specimens of the stem and branches of a greengage plum, in which a complete ring of bark about an inch in extent had been cut out, and in which the wood had been formed at the upper part above the cut, causing considerable swelling in the superior portion, while the inferior continued of its original size.

Dr Alexander Hunter, Madras, sent for exhibition photographs of—1. The Banyan tree; 2. *Adansonia digitata*, the Baobab tree; 3. Antiquities at Hurnpee, with Euphorbias growing out of the ruins; 4. View of the Horticultural Gardens at Madras.

F. Naylor, Esq., exhibited specimens of *Sagina nivalis* which he had collected on Ben Lawers, September 1863. Dr Murchison, London, says that he has in his herbarium two specimens marked *Arenaria rubella*, but which he believes to be *Sagina nivalis*. They were picked on Ben Lawers in 1847.

Mr William Stewart noticed the flowering of *Veronica speciosa* in the open air at Orchardton, Kilmarnock, 30th Dec. 1863.

A note from Dr Birdwood was read, regarding the Botanic Garden at Bombay.

Specimens of the work to be published illustrating the Grand Duke Maximilian's travels in South America, were exhibited.

11*th Feb.* 1864.—Professor BALFOUR, President, in the Chair.

The following gentleman was elected a Member of the Society:—

SAMUEL MACMILLAN, Esq.

The following donations to the Library were laid on the table:—

Proceedings of the Natural History Society of Dublin, Vol. IV., Part 1.—From the Society.

Proceedings of the Royal Horticultural Society, Vol. IV., Nos. 2, 3.—From the Society.

Verhandlungen des Naturforschenden Vereines in Brünn, 1862. —From the Society.

The following donations to the University Herbarium were announced:—

From Dr Lauder Lindsay, Perth—Collection of Dried Plants from New Zealand.

From Mrs Dr Dubuc—A large general collection of named Plants, contained in 33 boxes, also a mounted and named collection of Plants, principally British—the collections belonged to her son, the late Dr Emile William Dubuc, R.N.

From F. B. W. White, Esq.—Parcel of British Plants.

The following donations to the Museum at the Royal Botanic Garden were noticed:—

From Mrs Dr Dubuc—Thirty Specimens of Fossil Plants, and various Fruits and Seeds collected by her son, the late Dr E. W. Dubuc, R.N.

From Messrs P. Lawson & Son—Cones of *Pinus contorta*, from California.

From Mr James Anderson, Jamaica—Seeds of Mango, Avocado Pear, Akee, &c.

From S. C. Mackenzie, Esq.—Bunch of Rice from Calcutta.

The following Communications were read:—

I. *On Diplostemonous Flowers; with some Remarks upon the Position of the Carpels in the Malvaceæ.* By ALEXANDER DICKSON, M.D., Edin. (Plate I.)

It has long been known that in *Geranium* and its allies, the stamens superposed to the petals are external to those superposed to the sepals. That this is the case is very distinctly seen in the adult state, where the dilated bases of the filaments of the outer stamens overlap those of the inner.

Before these plants were examined organogenically, the outer stamens were, not unnaturally, assumed to be the older; and, as this involved a want of due alternation of parts, it was imagined that a third and outermost whorl of stamens alternating with the petals must have aborted, the idea being held to be countenanced by the frequent occurrence, in these plants, of five glands outside the andrœcium and alternating with the petals.* When, however, the development of the parts was observed, the unsoundness of this theory became evident; for it was found that the outer stamens are the younger; and, moreover, that the glands do not appear until shortly before the time of blossoming.†

The fact of the younger whorl of stamens being external to the older one is remarkable, as being exactly the reverse of what one would, *a priori*, have expected. The question as to how stamens should be so arranged, is an interesting one, and derives great importance from the researches of Payer having shown that this arrangement, so far from being uncommon, obtains in the greater number of diplostemonous dicotyledons.

In attempting an explanation of this difficulty, I am fully aware of the delicacy of the questions involved; and I would offer the result of my consideration of the subject, more as a suggestion worthy of being kept in view by those who may examine diplostemonous flowers, organogenically or otherwise, than as a definite solution of the problem. In short, I would submit a *possible* solution, to be substantiated or negatived by more extended and comprehensive observation of the facts.

Of diplostemonous flowers, there are two principal forms which demand our attention:—

1*st*, That in which the younger staminal whorl is the more internal, and the carpels, when of the same number, alternate with the younger stamens. Examples—*Coriaria*,‡

* Maout, Atlas de Botanique, p. 60. Balfour, Class-Book of Botany, p. 783, fig. 1435, with description.

† Payer, Organogénie, p. 59; pls. 12 and 13: the development of the glands in *Erodium* is shewn in pl. 12, figs. 17 and 21.

‡ Ibid., p. 49; pl. 10. *Limnanthes*, in all probability, comes under the same head. Although Payer describes the younger stamens in *L. Douglasii* as the more external, his figure (pl. 10, fig. 21) does not seem to bear out

Agrostemma, *Cerastium* (e.g. *C. triviale*),* *Lasiopetalum* (e.g. *L. corylifolium*),† *Lilium*, &c. (Pl. I., fig. 2.) Comparatively few dicotyledons, but almost all diplostemonous monocotyledons, fall under this head.

2*d*, That in which the younger stamens are the more external, and the carpels, when of the same number, alternate with the older stamens. Examples—*Geranium*, *Erica*, *Malachium*, &c. (fig. 1.) As I have already mentioned, the greater number of diplostemonous dicotyledons fall under this head.

In the first of these two forms of diplostemony (that in which the younger stamens are the more internal), the arrangement requires no explanation, as it corresponds with the ordinary centripetal evolution of successive whorls upon an axis.

The case, however, is widely different where the younger stamens are the more external. Here we seem to have a *centrifugal* succession of parts upon an axis. Have we any analogies to guide us in explaining this apparent anomaly? What suggests itself most naturally in this regard is perhaps the case of polyadelphous flowers, where the members of each staminal group are usually developed in centrifugal

the statement, for there the circle of the younger stamens appears almost to coincide with that of the older ones, or, if anything, to be somewhat smaller than it. In the more advanced stages, the younger stamens are very distinctly the more internal. At all events, the plant requires re-investigation upon this point.

* I have examined, with great care, the development of the stamens in *Agrostemma Flos-Jovis* and *Cerastium triviale*, and in both of them I can confidently state the younger stamens to be the more internal. I have given figures of young flowers of these two plants (Plate I., figs. 12 and 13). Payer has, on the contrary, stated that the *older* stamens in *Cerastium* are the more internal; but his figures do not indicate this very satisfactorily. To judge from my own experience of *C. triviale*, I should imagine it to be very difficult to determine which staminal whorl is the more internal, when the flower is viewed so much from above as those represented by Payer (Organogénie, pl. 72, figs. 7 and 8). In all flowers like *Cerastium*, where the receptacle is very convex, it is very necessary to obtain a completely side view, so as to see the difference in *elevation* of the different parts. In flowers with flat receptacles, on the other hand, the view from above is the most advantageous, as the parts are no longer on higher and lower elevations, but on larger and smaller circles.

† Organogénie, pl. 9, fig. 4.—Though the fact is not mentioned in his text, Payer's figure leaves no doubt as to the younger stamens (staminodes) in this plant being on a smaller and more internal circle than the older.

succession upon a cushion-like body which precedes their appearance. Payer has, however, by the most convincing arguments, determined the staminal phalanges of polyadelphous flowers to be compound stamens, the parts of which, when centrifugally developed, correspond to the basipetally developed leaflets or lobes of ordinary leaves; so that in these flowers we have no real examples of centrifugal succession of parts *upon an axis.* A curious arrangement, however, is described by Payer as occurring in *Opuntia*, where vast numbers of stamens are developed in centrifugal succession, and apparently distributed uniformly round the receptacle. We may arrive at a comprehension of this remarkable form, if we direct our attention to certain cases which appear to connect it with more easily intelligible forms. In *Brathys* (*Hypericum*) *prolifica*, Payer has shown that the staminal cushions (which usually remain distinct in the Hypericaceæ) become fused together, at an early period, into a single nearly uniform annular cushion, upon which the stamens make their appearance centrifugally. Again, in *Cistus*, he has shown that, in the early condition, the centrifugally developed stamens exhibit distinct traces of grouping, although the annular cushion, on which they are developed, is always entire. From *Cistus* we pass at once to *Helianthemum*, where all trace of grouping in the stamens disappears,* presenting us with a condition quite analogous to that in *Opuntia.* Such a series of forms leaves us in no doubt that in *Opuntia*, as in *Helianthemum* and *Cistus*, we have merely an extreme case of the fusion of compound stamens, which differs from that in *Brathys* only in being congenital, while in that plant it does not commence until a little after the appearance of the staminal cushions.

In connection with the above, I must not omit allusion to Payer's own determination of the signification of the andrœcium in *Cistus;* and as the questions suggested by it have no unimportant bearing upon the subject of this paper, I may be excused the apparent digression of commenting upon it. In this plant he has found that the stamens make their appearance in centrifugal succession upon an

* Organogénie, p. 17, plate iii. fig. 25.

annular cushion surrounding the centre of the floral axis, and in this wise:—in the first place, a circle of five stamens, superposed to the sepals, makes its appearance on the upper part of the annular cushion; later, alternate with and below these, a second circle of five stamens is developed; still later and lower, ten stamens appear, one on either side of each of the stamens of the second circle; lastly, a great number of stamens continue the centrifugal succession till the annular cushion is completely covered. "From this mode of staminal development," he says, "may we not conclude that the andrœcium of *Cistus* is composed of only two whorls: the one superposed to the sepals, in which the stamens remain simple and are the more internal; the other superposed to the petals, in which the stamens are grouped in five bundles, the stamens in each bundle appearing from above downwards."* Here, I cannot but think, Payer has introduced an unnecessary complication into the subject. His interpretation involves at least one serious improbability,—that in the same flower there should be both simple and compound stamens. What induced him to adopt this opinion was no doubt the consideration that, if the five stamens of the first degree, which are superposed to the sepals, were assumed to be the apices of staminal groups, the stamens of the second degree, which are superposed to the petals, must occupy neutral territory between these groups. He seems not to have taken notice of the fact which his figure† plainly indicates, that the same difficulty would, on his own supposition, occur lower down, where there are stamens (apparently of the fifth degree) superposed to the sepals, and therefore on neutral territory. The same thing appears still more strikingly in his figures of *Capparis* (the andrœcium of which he has recognised as being similar to that of *Cistus*), where it will be seen that in every second or third generation of stamens there are some occupying neutral territory. There seems, therefore, to be no more reason for considering the stamens of the second degree as the apices of staminal groups than for so viewing any of the other sta-

* *Op. cit.* pp. 16, 17.

† *Op. cit.* plate iii. fig. 13.

[*N.B.*—This page has been reprinted to admit of a correction in the text. It will further be necessary to add to the end of the first line of p. 91 the words "sepals or."]

mens of inferior degree which may be superposed to the petals. It appears to me that in *Cistus* and *Capparis*, all the stamens superposed to the petals (including of course the stamens of the second degree) must be looked upon simply as neutral structures, resulting from the coalescence of parts at the points of fusion of the contiguous groups, just as "interpetiolar stipules" are neutral structures, resulting from the coalescence of the stipules of opposite leaves at the points of fusion of the leaf-bases. This analogy will at once be admitted as a legitimate one, when it is remembered that stipules are nothing but lobes of the leaf.

To sum up, I think it is sufficiently evident from the foregoing considerations, that all the instances of indefinite stamens exhibiting an apparent deviation from the law of centripetal succession of leaves upon an axis, may be resolved into cases of compound stamens with development of lobes from above downwards.

From this conclusion we are naturally led to inquire whether those diplostemonous forms, where the younger stamens are the more external, may not in like manner be found to be merely *apparent* deviations from the ordinarily recognised laws of leaf-succession? We are at least bound to show that the phenomenon is incapable of explanation by the action of known laws, before we admit it to be an example of centrifugal succession of leaves upon an axis.*

In the *Geraniaceæ*, which, as I have already mentioned, exhibit this form of diplostemony, the genus *Monsonia* presents the remarkable peculiarity of having *ten* stamens in the younger and outer circle, arranged in five pairs superposed to the petals.† Payer considered that these five

* It may be observed that I have here left out of view the centrifugal evolution of ovules upon central placentas. I have done so, because it is vain to discuss this subject until we have more definite notions than at present prevail on the morphological value of the ovule itself. If the ovule represents a modified leaf, the ovular groups will probably fall under the same category with the staminal groups of polyadelphous plants, the placental elevations corresponding to the staminal bosses or cushions. If, on the other hand, the ovule is to be viewed as a bud or branch, analogies may be sought for among contracted centrifugal inflorescences.

† Similarly, in the *Zygophyllaceæ*, the five outer and younger stamens of *Zygophyllum*, &c., are replaced in *Peganum* by five pairs of stamens superposed to the petals.—Payer, Organogénie, p. 69; pl. 14, fig. 28.

pairs represented the five single stamens of the outer whorl in *Geranium* congenitally deduplicated.* At first sight, this view seems unexceptionable, since there is no doubt as to the parts being homologous. It appears to me, however, that if we were to invert Payer's statement, and say that in *Geranium* there is a congenital connation, in pairs, of the parts of the outer circle, which are distinct in *Monsonia*, we should thereby be enabled at once to explain the apparent anomaly of a younger whorl being external to an older one.

If, in fact, we adopt a line of argument analogous to that which Payer himself has employed in determining the signification of the epicalyx in the Potentillidæ, the whole difficulty, it seems to me, disappears. "In *Fragaria collina*," he says, "we always observe a calicule, composed sometimes of five leaflets alternate with the sepals, sometimes of ten leaflets grouped in pairs which alternate with the sepals; and, as this calicule appears always after the calyx, it cannot be doubted that it is formed by the stipules of the sepals." (*Op. cit.* p. 503.) Now, in the Geraniaceæ we have an outer staminal whorl, which consists sometimes (as in *Geranium)* of five stamens alternate with the parts of the inner whorl, and sometimes (as in *Monsonia)* of ten stamens grouped in pairs which alternate with the parts of the inner whorl. Moreover, these outer stamens appear after the inner ones. The parallelism of these two cases, as regards the number, position, and order of succession, of the parts, is quite complete; for we have in the Geraniaceæ an outer whorl whose relation to the inner one in these respects is exactly the same as that which the apparent outer calycine whorl of *Fragaria* bears to the inner one, or calyx proper.

The presumption, raised by this comparison, that the outer stamens in Geraniaceæ represent the lateral lobes of the inner or primary ones, distinct, or congenitally connate in pairs like interpetiolar stipules, amounts almost to a certainty, when we consider the mode in which the pentadelphous condition of *Monsonia* occurs, where each stamen of the inner whorl is connate with two of those of the outer

* *Op. cit.* p. 60.

—one on either side,—offering the closest analogy to a leaf with lateral lobes, or with adnate stipules. That the presumed interstaminal lobes—if I may so call them—in *Geranium* should so closely resemble, in all essentials, the primary stamens, need not surprise any one who bears in mind instances like *Galium cruciatum*, where the interpetiolar stipules differ in no respects from the leaves between which they are placed.*

It is evident that if the foregoing reasoning holds good as to the Geraniaceæ, we must extend its application to all the numerous cases where a similar diplostemonous arrangement occurs. All such plants, if my view be adopted, must be considered, strictly speaking, as isostemonous, the members of the outer staminal circle consisting merely of the lateral lobes of the primary stamens which form the inner circle.†

We may now proceed to examine what bearing the position of the carpels may have on this question. I have already stated that where the younger whorl of stamens is

* It may perhaps be thought that I am begging a question a little, in this allusion to the stipules of the Galiaceæ. Although the stipulary nature of these organs has been admitted by many very eminent botanists, yet I would not thus have assumed their opinion to be correct, had I not satisfied myself on the subject by examination of the course of development in *Galium aparine* where I can positively testify to the appearance, in the first place, of opposite leaves, followed afterwards by the development of intervening lobes, two or three on either side of the axis. I can hardly doubt that the leaf development in the Galiaceæ has been traced by others, but I have not succeeded in finding any references to it.

† It is perhaps worthy of remark that Payer has shown that the "staminodes" of *Linum* are not developed until after the fertile stamens are so far advanced as to indicate the distinction between anther and filament, and after the carpels have made their appearance. (See Organogénie, pl. 13, figs. 6 and 7; with description, p. 67.) Now, if these staminodes in *Linum* represent, as Payer suggests (*loc. cit.* p. 66), the staminodes in *Erodium*, and these last constitute a true whorl of sterile stamens, it is very difficult to understand their very late appearance. If, on the other hand, we adopt the view stated above, as to the younger and outer stamens being merely the lateral lobes of the primary ones, and analogous to leaf lobes or leaf stipules, this difficulty disappears; since there is nothing surprising in such structures appearing at a comparatively late period, and it is quite in accordance with what one observes in the case of staminal groups, where frequently the greater number of the stamens (lobes of the compound stamens) are developed *after* the appearance of the carpels.

the more internal (as in *Agrostemma*, &c.), the carpels, when of the same number, alternate with the younger stamens; but that, where the younger whorl of stamens is the more external (as in *Geranium*, &c.), the carpels alternate with the older stamens.*

The position of the carpels in the first of these two forms requires no explanation, since it is manifestly in accordance with the usual rule of alternation of floral whorls.

In the second form of diplostemonous arrangement (that in *Geranium*, &c.), the case is apparently very different. Here the carpels alternate with the older stamens, and are thus superposed to the stamens developed next to them in order of time. If the outer and younger stamens in this form be regarded as forming a true staminal whorl, and as of equal value with the older whorl, we must admit a very extensive series of exceptions to the rule of alternation of whorls. On the other hand, if we view the younger stamens here as forming a merely adventitious whorl, the symmetry becomes at once intelligible, since the stamens with which the carpels alternate are then the only ones of primary importance. The fact of my interpretation of this staminal arrangement satisfactorily explaining away such a large number of apparent exceptions to the rule of alternation of whorls, is, I think, no small argument in favour of its being well founded.

It is further to be noted that, when, in a group of plants exhibiting this pseudo-diplostemonous arrangement, the outer and younger stamens disappear, the position of the

* Some may be inclined to think that the circumstance of the carpels occupying different positions in these two cases is not a point of much importance; that the carpels are only growing out where they have most space for expansion. It is quite true, as matter of fact, that the carpels here do occupy the places where they have most room; but it appears to me impossible to reflect at all upon the arrangement of the parts of flowers, and admit that this arrangement is primarily dependent upon any such simple law of packing, if I may so express it. That such a law cannot be viewed as the basis of the arrangement of floral parts, must, I think, be apparent, when the not unfrequent instances of superposition of successive whorls are considered; for in these instances the parts are certainly not developed where there is most room. The fundamental conditions are more likely to be found in the modifications of a contracted spiral, than in the mere influence of surrounding parts upon nascent structures.

carpels is unaffected by such disappearance. This, of course, is only what might have been expected, if the outer stamens are viewed as merely accessory parts. Thus, in the Ericaceæ, we have in most of the species of *Ledum* the apparent diplostemony which is frequent in the family, while in *Ledum latifolium* the younger stamens disappear; and yet in this species the carpels are superposed to the petals just as in the others.* In *Epacris*, so nearly allied to the heaths, we have also an absence of the stamens superposed to the petals; and yet the carpels have the same position as in the Ericaceæ. Contrasted with this, it is striking to observe the consequence of the disappearance of the younger stamens in a group of plants exhibiting what I believe to be a true diplostemonous arrangement—one where the younger stamens are the more internal. I have already mentioned, as an example of this arrangement, a Büttneriaceous plant, *Lasiopetalum corylifolium*, the organogeny of which has been given by Payer. Here, the fertile stamens, which form the outer and older whorl, are superposed to the petals; the inner and younger whorl consists of staminodes alternate with the older stamens; and the carpels alternate with the staminodes, and are thus superposed to the petals.† In *Hermannia*, on the other hand, where only the fertile stamens superposed to the petals exist, the carpels are no longer superposed to the petals, but are now found superposed to the sepals, occupying, apparently, the place of the missing staminodes. In the Dombeyeæ, Baillon has described in *Astrapœa* a single whorl of *staminal groups*, with the carpels similarly superposed to the sepals.‡

* I am indebted to a friend for the facts regarding *Ledum*.

† In the Büttnereæ, moreover, Baillon has shown (*Adansonia*, II. p. 168) that in *Büttneria*, &c., the fertile stamens superposed to the petals are, as in *Lasiopetalum corylifolium*, older than the staminodes which alternate with the petals, and that the carpels are also, as in that plant, superposed to the petals. He has not stated which of these whorls is the more internal; but I can scarcely doubt that further investigation will show that the staminodes are the more internal.

‡ Payer has observed (Organogénie, p. 45) that in *Melhania* the carpels are similarly superposed to the sepals, and I have been able to confirm his observation. I have also found that in *Pentapetes* the carpels occupy the same position. It is probable that this arrangement obtains in the Dombeyeæ generally.

The genus *Melhania* exhibits the simplest form of andrœcium that occurs in

If my explanation of the apparent diplostemony in the Geraniaceæ be admitted, the analogy between such an arrangement and that of polyadelphous stamens will be at once allowed. In this regard, it is not unimportant to inquire whether these two forms may not sometimes pass into one another; and I believe that instances of a passage of this kind do really occur.

the Dombeyeæ. In *Melhania incana* there are five staminodes superposed to the petals, and five stamens which apparently alternate exactly with the staminodes. At first sight, the arrangement of parts in this plant seems very incomprehensible. Here are apparently two staminal whorls, and yet the carpels are superposed to the sepals, as in the isostemonous *Hermannia.* On further examination and reflection, however, I have come to the conclusion that the diplostemony here is only apparent, and that we have merely to do with a much reduced form of the staminal groups which are found in *Astrapæa.* In *Melhania incana*, the stamens and staminodes are connected below into a short tube or ring, which adheres to the petals at points corresponding to the bases of the staminodes. When, however, we detach the corolla from the flower, the staminal ring becomes broken into five parts, a stamen and a staminode coming away with each petal. In those flowers which I have examined, the stamen is always to the left side of the staminode, which, as I have already stated, is superposed to the petal, and adherent to it by its base. From the regularity with which the rupture of the staminal ring takes place, it seems reasonable to infer that the fertile stamens do not exactly occupy the indifferent or neutral position between the staminodes which we should expect, were this a case of two alternating whorls.

In *M. decanthera*, where, instead of one stamen, there are two in each interval between the staminodes, I find that of these two stamens there is always a longer and a shorter one, whose position to right or left as regards each other is constant in the same flower, although differing in different flowers. These facts seem to indicate that the pairs of stamens here have not an indifferent relation to the staminodes between which they are placed.

When we consider how easy the transition is from *Melhania* (through *M. decanthera*) to *Dombeya*, which again is closely allied to *Astrapæa* where Baillon has distinctly traced the origin of the stamens and staminodes to five groups superposed to the petals, we can scarcely doubt that the andrœcium of *Melhania* is referable to a polyadelphous type, and thus the difficulty as to the position of its carpels disappears.

It will probably be very difficult, in the Dombeyeæ, without organogenic examination, to apportion the fertile stamens to their proper groups, as they appear to vary very widely in their ultimate relation to the staminodes: thus, in *Dombeya viburniflora* (Bot. Mag. *tab.* 4568), the fifteen fertile stamens are collected into five bundles, which apparently alternate with the staminodes; while, in an opposite direction, an example may be found in *Trochetia grandiflora* (Bot. Reg. *tab.* 21), where the stamens and staminodes unite to form five phalanges, each phalanx consisting of a staminode from which four fertile filaments spring, two on either side.

In the Aurantiaceæ, we have, in *Citrus*, staminal groups, of which Payer has fully detailed the development. These groups alternate with the petals. In each group, the successive evolution of the stamens extends, in single line, laterally to right and left from a central oldest stamen superposed to a sepal; those stamens, therefore, being youngest, which are furthest removed from the central stamen or terminal lobe of the compound stamen.* Payer, moreover, describes the arrangement in *Tiphrasia trifoliata*, in the same family, as diplostemonous with the carpels superposed to the petals. The fact of the carpels here being superposed to the petals is important, as such an arrangement cannot fail to recall that in *Geranium*, *Erica*, &c., and of course suggests that the diplostemony in *Tiphrasia*, and many other Aurantiaceæ, is of the same spurious character as in these plants. Now, if this is the case, does not the andrœcium of *Citrus* bear to that of *Tiphrasia*, a relation exactly analogous to that which the whorl of apparent leaves of *Galium aparine*, consisting of opposite leaves, with a plurality of intervening lobes, does to that of *G. cruciatum*, where the intervening lobes are reduced to one on either side of the axis?

Again, in the Philadelphaceæ, there are, in *Philadelphus*, staminal groups, the development of which, as described by Payer, is strikingly like that in *Citrus*; while we have an apparent diplostemonous form occurring in *Deutzia*. But we seem further to have a form intermediate between *Philadelphus* and *Deutzia*, in *Decumaria*, which is described as having thrice as many stamens as petals, there being single stamens superposed to the sepals, and pairs of stamens superposed to the petals.† Thus, in the Philadelphaceæ, we have—1*st*, in *Philadelphus*, compound stamens with indefinite lobes; 2*d*, in *Decumaria*, a reduction in the number of the staminal lobes, resulting in a condition apparently analogous to that in *Monsonia*; and 3d, in *Deutzia*, an apparent diplostemony, probably analogous to that in *Geranium*, &c.‡

* Payer, Organogénie, p. 114, pl. 25. † Endlicher, Genera, p. 1187.

‡ *Visnea*, in the Ternstrœmiaceæ, is probably another example of a reduced polyadelphous form. In *V. mocanera* Payer has shown that, of its 15 stamens,

Although we must avoid attaching undue weight to the foregoing facts as to the Aurantiaceæ and Philadelphaceæ—the organogenic evidence being far from complete—yet it may be allowed, I think, that such facts at least heighten the presumption in favour of the justness of my views as to the constitution of the andrœcium in *Geranium*, &c. If my conjectures are well founded, it is possible that the younger stamens in *Tiphrasia* and *Deutzia* may be found to appear on the same circle with the older ones, just as in *Citrus* and *Philadelphus* all the staminal lobes are on one circle, or nearly so.

Having stated my reasons for believing the diplostemony in *Geranium* and the like, to be merely apparent, I would now allude to certain objections which may be urged against that view.

It may be said that such diplostemony may occur in plants whose leaves are neither lobed nor stipulate. In *Malachium*, for example, the leaves are entire and ex-stipulate. Regarding such an objection, I would observe that, in the case of compound stamens, which I believe affords us the closest analogy with this form of diplostemony, there is not only no necessary coincidence between the lobed or compound condition of the stamens and a similar condition of the leaves in the same plant, but there is not even any neces-

5 are superposed to the sepals, and 10, in 5 pairs, to the petals. The stamens superposed to the sepals are the first developed, and appear simultaneously. In each of the pairs superposed to the petals, however, there is an older and a younger stamen. From Payer's figure (Organogénie, pl. 154, fig. 25), it would appear that the position of the older and younger stamen, in each pair, to right and left, as regards each other, is uniform; so that each of the primary stamens superposed to the sepals has an older stamen on the one side and a younger on the other. There is evidently here an alternate succession of secondary staminal lobes, analogous, so far as it goes, to what has been described by Payer in *Malvaviscus*, and by Payer and Baillon in *Euphorbia*. The andrœcium of *Visnea* cannot fail to recall that of *Melhania decanthera*, described in a former note, and I have no doubt that the two cases are quite analogous, only, the apices of the reduced staminal groups are represented by staminodes in *Melhania decanthera*, the intervening unequal pairs of lobes being alone fertile.

Aristotelia, in the Tiliaceæ, is evidently also a reduced polyadelphous form, being described as having 5 inner stamens superposed to the sepals, and 10 outer in 5 pairs superposed to the petals (Payer, *Leçons sur les fam. nat.* p. 278.)

sary correspondence between the mode of succession of the staminal and foliar lobes, when both stamens and leaves, in the same plant, happen to be lobed. Thus, in the Hypericaceæ, Myrtaceæ, &c., we have examples of families characterised by their compound stamens, and yet remarkable for the simplicity of their leaves ; and in *Cajophora* (*Loasa*) *lateritia*, where the stamens are developed in succession from above downwards, or basipetally, upon the staminal cushions,* I find the pinnæ of the leaf to be developed from below upwards, or basifugally. From such considerations it may be inferred that we need not expect any necessary association of lobed or stipulate leaves with pseudo-diplostemonous flowers.† Should any one be inclined to imagine that the facts I have just been stating at all invalidate Payer's determination of staminal groups as compound stamens, I would have it borne in mind that it is no more surprising that there should be entire leaves and compound stamens in the Myrtaceæ, &c., than that in many other plants there should be lobed leaves and simple stamens ; or, again, that in *Cajophora* there should be basipetal development of staminal lobes with basipetal development of leaf-lobes, than that these two modes of development should often occur together in the same leaf, as they do in the so-called mixed leaf-formation.‡

* Payer, Organogénie, p. 391, pl. 84.

† I may observe, however, that in some plants with pseudo-diplostemonous flowers, the leaves are not only stipulate, but exhibit a tendency to the formation of interpetiolar stipules. A. P. de Candolle has remarked that "several Geraniaceæ present this peculiarity [fusion of stipules] in a very evident manner." (*Organographie Végétale ;* Paris, 1827 ; tome i. p. 339.)

In some Geraniaceæ I find a very remarkable condition, which, so far as I know, is without parallel in other plants. In *Erodium hymenodes*, for example, where all the leaves are opposite, there are invariably, between each pair of leaves, on the one side of the axis a single, entire or slightly bifid, *interpetiolar stipule*, and on the other side a pair of *free stipules*, the one of which pair overlaps the other, from their bases passing each other. I find a similar arrangement in *E. cicutarium*, *Pelargonium zonale* and allied forms, *P. scutatum*, &c., whenever the leaves happen to be opposite.

Again, in *Spergula* (which, like *Malachium*, has ten stamens, and five carpels superposed to the petals) there are interpetiolar stipules ; and similar stipules exist in the allied *Lepigonum*.

‡ *Cobæa scandens* affords a very pretty example of the association of basipetal

It has been suggested to me, that if we were to admit the occurrence of accessory stamens, there would be no reason why these might not sometimes be placed on the same circle with, or even internal to, the primary ones, just as stipulary lobes may appear on the same level with the base of a leaf, or, as in the so-called axillary stipule, above it or on its inner face. I have already, when treating of *Tiphrasia* and *Deutzia*, admitted the possibility of accessory stamens being on the same circle with the primary ones. As to accessory stamens being internal to the primary ones, I think it not at all improbable that such an arrangement may also occur; and, in compound stamens, an analogous phenomenon would be found in the Myrtaceæ, where the staminal lobes appear in centripetal succession as regards the axis.* Now, the possibility of accessory stamens being internal to the primary ones, may be supposed by some to invalidate the morphological distinction of diplostemonous flowers into two forms, which I have endeavoured to estab-

with basifugal development of leaf-lobes. Here, I find a succession of lobes from a point both upwards and downwards. The upper pair of foliaceous pinnæ appears in the first instance; and, from this, as a point of departure, the cirrhose pinnæ appear in basifugal succession towards the apex of the leaf, while the other foliaceous pinnæ appear successively towards its base. Payer has described an analogous succession from a midway-point upwards and downwards, in the serrations of the leaf-lobes in *Cannabis sativa* (Organogénie, pl. 61, fig. 28; with descr. p. 283).

* Organogénie, pp. 460–1, pl. 98. Payer has, somewhat hastily, I think, compared the compound stamens in the Myrtaceæ to leaves with lobes developed from base to apex, or basifugally. (*Op. cit.* p. 718.) His figures however, distinctly indicate that here, as in the ordinary forms of compound stamens, there is a mesial stamen or lobe of the compound stamen, from which, as a point of departure, the evolution of the other stamens extends; and it appears to me improbable that a basifugal succession of lobes should be initiated by the development of a lobe in the middle line at the base of the compound stamen. The phenomenon seems more naturally explained by supposing that the first developed lobe of the myrtaceous compound stamen corresponds to the first developed or terminal lobe in the ordinary form, in which case the evolution in both forms would be basipetal—the only difference between the two being that, while in the Hypericaceæ, &c., the lobes are developed on the back or outer face of the rachis of the compound stamen (the staminal cushion), in the Myrtaceæ they appear on its front or inner face. In confirmation of this opinion, I may refer to the highly developed staminal groups in *Melaleuca purpurea*, where, in each phalanx, the stamens evidently proceed from the *inner* face of the flattened and elongated rachis.

lish. As to this, I would state that, although the accessory or non-accessory nature of the younger stamens when internal may be very difficult to determine in some cases, where the carpels, from multiplication, or reduction in number, fail to afford any indications, yet, when we consider the relations of the parts in the flowers of *Coriaria*, *Agrostemma*, *Cerastium*, &c., where the gynœcium is isomerous with the staminal whorls, and the carpels alternate with the younger stamens, we can have no doubt as to such flowers being truly diplostemonous, and therefore morphologically distinct from those of *Geranium*, *Erica*, *Malachium*, &c., where the younger stamens, in being external to the older, occupy a position irreconcilable with the idea of their forming a genuine whorl, and where the carpels alternate with the older stamens.

In the last place, we may consider certain anomalous and somewhat perplexing pseudo-diplostemonous forms, occurring in the Sapindaceæ and Polygalaceæ.

I have constructed, in accordance with Payer's observations, diagrams of the flowers of *Polygala*, *Kœlreuteria*, and *Cardiospermum*. In these plants, the outer and younger (accessory) whorl of stamens is incomplete.

In *Polygala* (Pl. I. fig. 9), the lower or anterior stamen of the primary, and the upper or posterior stamen of the accessory, whorl are absent.* It is worthy of remark, that in this plant, while the disappearance of the anterior primary stamen appears to be the direct cause of a solution of continuity of the staminal tube, the disappearance of the posterior accessory stamen is unaccompanied by any such solution.

In *Kœlreuteria* (Pl. I. fig. 11), the primary staminal whorl is complete, while the accessory whorl is reduced to three stamens alternate with sepals 1 and 4, 4 and 2, 5 and 3.† In *Pavia* (*Æsculus*), Payer has described a similar arrangement,—only, the accessory stamen between sepals 1 and 4 (and sometimes also that between sepals 4 and 2) is absent, and that between sepals 5 and 3 is occasionally resolved into two, then resembling those in *Peganum* and *Monsonia*.‡

Now, it may seem an objection to my doctrine of accessory stamens, that, in such plants, it requires us to admit

* Organogénie, p. 140. † Ibid, pp. 150–1. ‡ Ibid, p. 130.

that some members of a primary whorl may be provided with accessory lobes, while others are not. Regarding this objection, it is sufficient for me to advert to the remarkable condition of the calyx of the hundred-leaved rose, where only two sepals are provided on both sides with lateral lobes: two of the remaining three being destitute of them, and the other having a lobe on one side only.

In *Cardiospermum* (fig. 10), the number and position of the stamens are exactly the same as in *Kœlreuteria:* the stamens superposed to the petals being reduced to three, and alternating with the same sepals as in that plant. It cannot be doubted that, in the two cases, the andrœcia are essentially the same, although it is to be remarked that, while the three carpels are, in *Kœlreuteria*, superposed to sepals 1, 2, and 3, in *Cardiospermum* they alternate with sepals 1 and 4, 4 and 2, 5 and 3. In *Cardiospermum*, however, the stamens in each whorl, instead of appearing simultaneously, as in *Kœlreuteria*, are developed in a remarkable succession, which I have indicated by the numbers accompanying the stamens in the diagram (fig. 10). In the first place, the two stamens which alternate with sepals 1 and 4, 4 and 2, make their appearance; next, the two stamens superposed to sepals 1 and 2; then, the three stamens superposed to sepals 3, 4, and 5; and lastly, the stamen alternate with sepals 3 and 5.* Payer has endeavoured to render intelligible the remarkable mode of staminal succession, in this and other analogous cases, by supposing that the irregularity of development, which so frequently manifests itself after the appearance of floral parts, is congenital in such cases; and it is hardly possible to doubt that his explanation is correct. The anomalous succession is evidently the effect of a disturbing force delaying or arresting, for a time, the appearance of some of the parts, and thus materially affecting the order of staminal evolution. This disturbing force seems to act in quite an arbitrary manner, as it affects different plants in very different manners: thus —to take examples from Payer's work—in *Viola odorata*, the stamens appear successively from before backwards; in the Resedaceæ, from behind forwards; while, in *Cardio-*

* Organogénie, pp. 150–1.

spermum, the succession may be described, in general terms, as obliquely from side to side. As I have already stated, the two stamens which first appear in *Cardiospermum*, are those which alternate with sepals 1 and 4, 4 and 2. Now, it may be supposed by some to be a formidable, if not fatal, objection to my views, that two of the supposed accessory stamens should appear before the primary ones to which they belong. At first sight, such a mode of appearance seems very improbable; yet, when we consider the arbitrary manner in which the disturbing force affects the order of staminal succession, we need scarcely be surprised even at such a result. At any rate, it cannot, *à priori*, be said to be more improbable that the appearance of primary staminal lobes should be delayed by a disturbing force until after that of their accessory or lateral lobes, than that the appearance of a normally older staminal whorl should be delayed until after the appearance of some of the parts of a normally younger one, which must be admitted on the ordinary supposition of there being two genuine staminal whorls. I do not think, therefore, that the case of *Cardiospermum*, although certainly a very strange one, can fairly be urged as invalidating my views.

While engaged in the attempt to determine the morphological constitution of double staminal whorls, I was led, incidentally, to examine the position of the carpels in some of the Malvaceæ.

I have already stated, regarding the Büttneriaceæ, that where, in these plants, there are two staminal whorls, the carpels (as alternating with the younger staminal whorl) are superposed to the petals,—*e.g.* in *Lasiopetalum*, *Büttneria*, *Melochia*, &c.;—but that where the andrœcium is reduced to a single whorl (of simple or compound stamens), the carpels are superposed to the sepals, as in *Hermannia* and the Dombeyeæ.

The researches of Payer leave no doubt that the andrœcium of the Malvaceæ consists essentially of a single whorl of five compound stamens, superposed to the petals. With a staminal arrangement so closely analogous to what Baillon

has described in *Astrapœa*, we may expect to find the carpels, when of the same number, superposed to the sepals, as in that plant. Payer, indeed, has stated that the Hermanneæ, Dombeyeæ, and Bombaceæ, in which the carpels are superposed to the sepals, are distinguished thereby from the Malvaceæ, Sterculeæ, and Lasiopetaleæ: * but, as regards the Malvaceæ, I believe it can only have been through an oversight that he has associated them with the Lasiopetaleæ, since he describes the carpels in *Hibiscus* as being superposed to the sepals.† So far as my observations extend, the rule seems without exception, that in 5-carpellary Malvaceæ the carpels are superposed to the sepals, just as in the Dombeyeæ. I have ascertained the occurrence of this arrangement in the following:—(Hibisceæ) *Hibiscus*, *Paritium;* (Sideæ) *Lagunea.* Moreover, in the Malopeæ, where Payer has shown the gynœcium to consist of five carpellary groups, I find that, in *Malope*, these groups are superposed to the sepals; so that in this plant we have a similar arrangement to that in *Hibiscus*—only, the five simple carpels of *Hibiscus* are replaced in *Malope* by five carpellary groups (or compound carpels, as they may be termed, being developments evidently of an analogous character with the compound stamens of polyadelphous plants). Payer has described the angles of the pentagon formed by the carpellary groups in *Malope* as superposed to the sepals: but I am quite satisfied that his statement is erroneous. In flowers at or near maturity, there is, sometimes, a slight want of perfect superposition of the carpellary groups to the sepals: but this seems to be never to such an extent as to justify Payer's statement. In the early condition of the ovarian pentagon, the superposition of its *angles* to the petals is quite unmistakeable. The cavity of the staminal tube is five-sided, the sides alternating with the petals; and the carpellary pentagon, in its origin, is pretty accurately fitted into the bottom of this cavity. ‡

The superposition in many Ureneæ of the loculi to the

* Organogénie, pp. 44-5. † Ibid., p. 83.

‡ I have not had an opportunity of examining the position of the carpellary groups in *Kitaibelia;* and there seems to be considerable confusion in Payer's works, on this point, as these groups are described in the "Organogénie" (p. 84) as alternate with, and in the "Eléments de Botanique" (p. 209) as superposed to, the petals.

petals is only an apparent exception to the rule I have stated above, as to the position of the carpels in 5-carpellary Malvaceæ; for the researches of Payer on the organogeny of *Pavonia* leave no doubt that in this tribe the five loculi merely represent the fertile members of a circle of ten carpels, to which the ten styles correspond. In *Pavonia*, the gynœcium, in its origin, consists of ten carpellary mammillæ. Of these, however, only five have loculi developed in connection with them—every second carpel being, so to speak, barren. The ten carpels all equally develope styles; so that in the advanced condition there are five styles prolonged upwards from the loculi, and five continuing the lines of the dissepiments.* In *Malvaviscus*, Payer describes the loculi (corresponding to the fertile carpels) as superposed to the petals.† In *Urena* (*U. americana*, *U. lobata*, *U. scabriuscula*, *U. sinuata*), I find the same arrangement. In *Pavonia*, I have ascertained the remarkable fact that the loculi are sometimes superposed to the sepals, and sometimes alternate with them. Thus, in *P. typhalea*, *P. begoniæfolia* (Gardner), *P. odorata*, *P. umbellata*, and *P. zeylanica*, the loculi are superposed to the sepals; while, in at least one species, named in the Edinburgh University Herbarium *P. hastata*,‡ the loculi are certainly alternate with them, as in *Malvaviscus* and *Urena*.§

* Organogénie, p. 85, pl. 7.

† Leçons sur les fam. nat. des plantes, p. 281.

‡ I have expressed myself thus guardedly as to the specific name of this plant, because, by its indefinite stamens, it differs from that to which Baillon refers as *P. hastata* (Adansonia, II. p. 176), which is described by him as having only five stamens in the adult state. The Edinburgh plant agrees with the description of *P. hastata* in Decandolle's "Prodromus" (vol. i. p. 443), in its lanceolate hastate dentate leaves, axillary unifloral pedicels, and five-leaved involucre. I cannot say much as to the colour of the petals, except that a deep red or purplish blotch remains at the base of each. The whole plant (especially the stem, the under side of the leaves, the involucre, and the sepals) is downy, being covered with a short stellate pubescence. The plant which Payer has examined as *P. hastata* appears to perfect a considerable number of stamens, as is seen in his representation of the andrœcium "shortly before blossoming," where there would seem to be 25 stamens, or thereabouts (Organogénie, pl. 7, fig. 9; with description, p. 38).

§ The position of the fertile carpels seems to offer a much more important character by which the genus *Pavonia* may possibly be disintegrated, than any derived from the awned or awnless condition of the fruit, the relative length of the involucre to the calyx, &c.

In constructing those diagrams which illustrate arrangements in the Malvaceæ (figs. 5, 6, 7, and 8), having found great difficulty in giving diagrammatic expression to the staminal groups, I have represented the said groups by symbols of infinity, which conveniently enough indicate the indefinite number of the staminal lobes.

Explanation of Plate I.

[Figs. 1–13 are from my own designs. Figs. 14 and 15 are taken from Payer's "Organogénie," plate xiii. figs. 28 and 32. The diagrams are constructed with the utmost conventional uniformity, being merely intended to represent the *position* of the parts, not their *form*. In the diagrams, the posterior aspect of the flower is above, the anterior below, and the stamens are numbered in the order of their appearance.]

Fig. 1. Arrangement in *Geranium*, *Malachium*, &c. Younger (accessory) stamens external. Carpels alternate with older (primary) stamens.

Fig. 2. Arrangement in *Coriaria*, *Agrostemma*, *Cerastium*, &c. Younger stamens internal, probably forming a genuine whorl. Carpels alternate with the younger stamens.

Fig. 3. Arrangement in *Lasiopetalum corylifolium*, and probably in *Büttneria*, *Melochia*, &c. Outer and older stamens fertile, and superposed to the petals; inner and younger sterile, and alternate with the outer. Carpels, as in fig. 2, alternate with the younger (sterile) stamens.

Fig. 4. Isostemonous arrangement in *Hermannia*. Fertile stamens, as in the last, superposed to the petals. The carpels are superposed to the sepals, apparently replacing the staminodes of the last form.

Fig. 5. Arrangement in *Hibiscus*, *Paritium*, and *Lagunea*. Same as last form, except that, instead of five simple stamens, there are five staminal groups (indicated by symbols of infinity).

Fig. 6. Arrangement in *Malope*. Same as last, except that, instead of five simple carpels, there are five carpellary groups.

Fig. 7. Arrangement in *Pavonia Typhalea*, *P. begoniæfolia*, *P. odorata*, *P. umbellata*, and *P. zeylanica*. Staminal groups as in figs. 5 and 6, superposed to the petals. Ten carpels; five fertile, superposed to the sepals, and five sterile, superposed to the petals. The sterile carpels are indicated by small circles alternate with the loculi.

Fig. 8. Arrangement in *Malvaviscus*, *Urena*, *Pavonia* sp. (*hastata?*). Same as last form, except that those carpels which are sterile there, are fertile here, and *vice versâ*.

Fig. 9. Arrangement in *Polygala*, as described in the text.

Fig. 10. Arrangement in *Cardiospermum*, as described in the text. The sepals are numbered in the order of their appearance. Sepals 3 and 5 become connate, and the petal (indicated in outline) which alternates with them aborts. If an oblique line be drawn, as in the diagram, through sepal 4 and the abortive petal, the parts are arranged symmetrically on either side of it. This imaginary line, by torsion of the peduncle, becomes antero-posterior, the abortive petal becoming posterior (superior). See Payer's "Organogénie," p. 153.

Fig. 11. Arrangement in *Kœlreuteria*, as described in the text. As in *Cardiospermum*, the petal alternating with sepals 3 and 5 aborts.

Fig. 12. Young flower of *Agrostemma Flos-Jovis*, just before the appearance of the carpels. The younger stamens are internal to the older ones. *s*, sepal; *p*, petal; *st*, older stamen; *st'*, younger stamen.

Fig. 13. Young flower of *Cerastium triviale*, at same stage as the last. The younger stamens, as in *Agrostemma*, are internal to, or on a higher level than, the older ones. *sa*, *sp*, *sl*, anterior, posterior, and lateral sepals; *p*, petal; *st*, older stamen; *st'*, younger stamen; *ax*, convex extremity of the floral axis; *b*, *b*, lateral bracts, with secondary floral axes fl^2, fl^2, developed in their axils.

Fig. 14. (From Payer). Young flower of *Monsonia ovata*. *s*, sepals; *p*, petals; et^a, older and inner (primary) stamens, superposed to the sepals; et^o, younger and outer (accessory) stamens, superposed in pairs to the petals; *cp*, carpels, superposed, as in *Geranium*, to the petals.

Fig. 15. (From Payer). Andrœcium and pistil from a flower of *Monsonia ovata*, at the time of blossoming. Each of the primary stamens has become connate with the two accessory stamens adjacent to it, one on either side, so that the andrœcium seems now composed of five phalanges superposed to the sepals.

II. *On the Cinchona Plantations in connection with the Botanical Garden at Bath, Jamaica.*—By Nathaniel Wilson, Curator of the Garden. Communicated by Dr Lauder Lindsay.

The most important event in the history of this Botanic Garden for many years past has been the introduction, by seeds, of the quinine-yielding Cinchona in the autumn of 1860. By the month of October 1861, I succeeded in rearing upwards of 400 healthy plants, quite ready for planting out; but unfortunately the selection of a proper site for their final establishment was overlooked, and in consequence one-half of the number perished. Being anxious, however, to test the adaptability of the plants for cultivation in the higher altitudes of this island, I caused the whole of them to be removed in small pots to Cold Spring Coffee Plantation, the elevation of which is about 4000 feet. I soon found the climate and soil of this locality to be all I could desire for the plants; and as it afforded every facility for carrying out so valuable an experiment, I at once availed myself of it, and planted out in the coffee fields on the 16th November several plants of each species, then about two or two and a half inches in height. In twelve months after, a plant of the red bark, *Cinchona succirubra*, had attained to the height of forty-four inches, with leaves measuring thirteen and a half inches in length, by eight and three-quarters in breadth. The same plant, now two years old, measures six feet in height with ten branches, having a circumference of stem at base of four and a half inches. The plants of *Cinchona micrantha*, grey bark, being of more slender habit of growth, have not made such rapid progress; the highest has attained to five feet with three branches. The leaves, however, are larger, and measure fourteen by ten inches. So far the experiment has thus proved eminently successful. It would be difficult to find more healthy trees in the forests of that neighbourhood; and, in about three or four years hence, they may be expected to produce seeds. In the meantime they can be largely increased by cuttings and layers, in the hands of a skilful propagator. During the months of August and September

1862 the collection was again removed to Bath. The plants were at this time eighteen or twenty months old, a critical period for forest trees in flower pots under artificial treatment, and in a climate too so uncongenial for them as that of Bath, which would have terminated their lives had they not soon afterwards (13th October) been planted out at Mount Essex, near Bath, at an altitude of two thousand feet, or little more. This site, as a temporary one, was had recourse to to save the plants alive until a better could be obtained; and so far it has answered the purpose, and a majority of the plants are healthy, but have not made such rapid progress as could have been desired. The soil is too loamy and by far too stiff to admit of a free and rapid escape of the rains which fall here in torrents during the greater part of the year, and the altitude far too low for the Peruvian barks. The red bark thrives at a much lower altitude, and, being a more hardy tree, the plants are more healthy. A very important fact has now been established—viz., that the climate of our higher, and many of our intermediate, mountains is suited for the growth of the most valuable species of quinine-yielding plants—*Cinchona succirubra*. A knowledge also of the method of increasing the plants, and of the soil best adapted for their full development has been obtained.

III. *Notice of the Occurrence of* Woodsia alpina (hyperborea) *in Gaspé, Canada East.*—By George Lawson, LL.D., Professor of Chemistry, Dalhousie College, Halifax, Nova Scotia.

Professor Lawson stated that this rare fern (*Woodsia alpina*) had not been found by any recent collector in Canada, and no one knew where to look for it. He had recently described, however, in connection with *Woodsia glabella*, and under the name of var. *Belli*, a remarkable Woodsia found in Gaspé on the Dartmouth River, 20 miles from its mouth, by his former pupil, Mr John Bell. This plant, on further examination, turned out to be the *Woodsia alpina*. He enclosed a specimen.

IV. *Remarks on* Myrica cerifera, *or Candleberry Myrtle.*—By Professor Lawson, Dalhousie College, Halifax.

I found *Myrica cerifera* a few days ago in some quantity on a hillside near Halifax, with small birds feeding on the berries. It is variously called Wax Myrtle, Candleberry Tree, and Tallow Shrub, in reference to the wax with which its berries are coated. The wax is yellowish green, emitting a fragrant balsamic odour not so unctuous as bees' wax, nor so brittle as resin, sinking in water, whereas bees' wax swims, sp. gr. 1·015; fusing point, 110°. The wax is obtained by boiling the berries in water. The plant is common all over the hills overlooking the innumerable bays and harbours of the Nova Scotian coast, but I do not know that the product has been made an object of commerce here. Some years ago Professor Simmonds called attention to the desirability of encouraging the production of Myrtle wax, and gave in the "Pharmaceutical Journal, vol. xiii. p. 418," very full details respecting the wax-yielding Myrtles of South Africa, and the mode of manufacturing the product. The species which is cultivated at the Cape as the best South African one is *Myrica cordifolia*. Professor Simmonds speaks of our American Myrtle wax (*M. cerifera*) as identical commercially with that produced at the Cape. A consignment of Cape wax (2561 lbs.) yielded a clear profit of L.54, 4s. 5d., after payment of all expenses, collecting, shipping, &c. Should any manufacturer in Britain feel an interest in the matter, I will be happy to

furnish such additional information as may be procurable here. In "Annales des Sciences Naturelles 1855," it is stated that the European *Myrica Gale* yields a little wax. The *Myrica cerifera*, like its African congener, is a coast plant. I never saw it in Upper Canada; but Professor Gray gives a station on Lake Erie. On the Halifax hills it is a small spreading bush, three or four feet high, forming a close brush. At this season the stems are leafless, but the withered leaves scattered about still retain their fragrance.

V. *Note on the leaves of Ulex (Whin).* By Professor Lawson, Dalhousie College, Halifax.

The seedling *Ulex* has at first no spines. The young stem is clothed with leaves—from twelve to twenty in number—these are shortly petiolate and trifoliate, consisting each of three small elliptical hairy articulated leaflets. When the stem becomes five or six inches in length (usually) the trifoliate leaves cease to be developed, and spines are then produced. We thus see that in *Ulex* the perfect leaves appear during the early period of the plant's development, while in the Australian *Leguminosæ*, their production is delayed till the maturity of the plant. *Ulex*, however, is truly a plant with compound trifoliate leaves, not simple-leaved, as stated in many works. The above facts were ascertained from observing the development of some seedlings of the whin raised by Mrs Lawson in a flower-pot, from seeds brought from Ireland by Dr Dickson, Dean of the Medical Faculty of Kingston.

VI. *Notice of Mosses found in the neighbourhood of The Burn, near Brechin, Forfarshire.* By Mrs M'Inroy. Communicated by Mr John Sadler.

Mrs M'Inroy gave a list of mosses to be met with in the neighbourhood of The Burn, so far as at present known. The greater proportion are to be found within the policies, and principally on the banks of the North Esk, which flows through the grounds. The list contains 145 species, but Mrs M'Inroy states that she believes this by no means exhausts the mosses of the place.

Andreæa rupestris
Antitrichia curtipendula
Atrichum undulatum
Aulacomnion androgynum
    palustre
Bartramia arcuata
    fontana
    Halleriana
    ithyphylla
    pomiformis
Blindia acuta
Brachyodus trichodes
Bryum alpinum
    argenteum
    atropurpureum
    capillare
    carneum
    crudum
Bryum inclinatum
    julaceum
    pallens
    pseudo-triquetrum
    roseum
    sanguineum
    Wahlenbergii
Campylopus brevipilus
Ceratodon purpureus
Cinclidotus fontinaloides
Climacium dendroides
Dicranum heteromallum
    majus
    palustre
    pellucidum
    scoparium
    squarrosum
    subulatum

Dicranum varium
Didymodon rubellus
Diphyscium foliosum
Distichium capillaceum
Encalypta ciliata
Fissidens adiantoides
bryoides
taxifolius
Fontinalis antipyretica
squamosa
Funaria hygrometrica
Grimmia pulvinata
Gymnostomum curvirostrum
tenue
Hedwigia ciliata
Hookeria lucens
Hypnum aduncum
albicans
commutatum
confertum
crassinervium
crista-castrenses
cupressiforme and varieties
cuspidatum
denticulatum
filicinum
heteropterum
loreum
molluscum
palustre
piliferum
plumosum
polygamum
populeum
prælongum
pulchellum
purum
resupinatum
revolvens
rivulare
ruscifolium
rutabulum
Schreberi
scorpioides
splendens
squarrosum
stellatum
striatum
Swartzii
tamariscinum
triquetrum
uncinatum
undulatum
velutinum
Isothecium alopecurum
myosuroides
myurum
Leptobryum pyriforme
Leskea sericea
polycarpa
Leucobryum glaucum
Mnium hornum
punctatum
rostratum
serratum
subglobosum
undulatum
Neckera complanata
crispa
Omalia trichomanoides
Orthotrichum affine
Bruchii
crispum
Drummondii
leiocarpum
rupestre
stramineum
tenellum
Phascum subulatum
Physcomitrium pyriforme
Pogonatum aloides
nanum
urnigerum
Polytrichum commune
juniperinum
piliferum
Pottia truncata
Ptychomitrium polyphyllum
Racomitrium aciculare
canescens
fasciculare
heterostichum
lanuginosum
Schistidium apocarpum
Seligeria recurvata
Sphagnum acutifolium
cymbifolium
fimbriatum
compactum
contortum
Tortula convoluta
muralis
ruralis
subulata
tortuosa
unguiculata
Trichostomum rigidulum
Weissia controversa

The following note to Professor Balfour from Dr John Kirk was read:—
"I enclose two pods of a tree nearly allied to *Bauhinia* or *Copaifera*,

but of a new genus. Perhaps you may succeed in growing it. As yet the flowers are unknown, for my specimens were lost. This tree has hard black wood, called by the Portuguese *Pao ferro;* by the Bechuanas, *Mopane.* I have got the foliage and fruit, but, being a new genus, the flower is a sad want. It inhabits the driest and most baked clay plains; no heat kills it, the leaves, like those of Australian forests, turning their edge upwards when the sun shines very powerfully. The testa of the seed is full of resin in large cysts, and the cotyledons are convoluted like the surface of the human brain."

A note from Mr W. J. Haig, Dollarfield, was read, in which he says:—"I enclose a specimen of a plant which I have just received from a cousin who is settled in the Banda Oriental Republic of Uraguay. He writes to me:—'I should be glad if you could get a scientific opinion on the following case:—It had long been a known fact here that sheep removed from the province of Buenos Ayres to the Banda Oriental, or imported from Europe, are liable to die in great numbers during the first fortnight after arriving. I saw an instance myself last week. At an *estancia* about five leagues from here, the owner had just received from Buenos Ayres sixty rams and ewes freshly imported from Europe, which cost L.15 per head: of these, fourteen died in five days. It is believed that the mortality arises from the sheep eating a plant called *min-min,* peculiar to this province. I enclose a twig of it. It grows in patches about the size of one's hand, and the twig enclosed is of average height. The stomach and intestines after death are found much inflamed; and in some cases the under side of the skin is quite red with effused blood. I may add that sheep born here, or acclimatised, are in no way injured by the plant—in fact, they almost entirely avoid it." This seems very analogous to the effect which the twigs of the yew tree have on animals here; and I should think that the only way to avoid the danger would be to put the animals for the first week or two in an enclosure cleared of this plant. By this time desire for green food would be somewhat abated, and they would, like the native born, become more discriminating.

Professor Balfour stated that the specimen of the plant sent was a mere twig without flowers or fruit, and he was unable to say what it was.

A note from N. B. Ward, Esq., was read, in which he states:—"The *Fucus* which was discovered by Professor Harvey and myself at Kilkee, and which was first published as *Fucus furcatus,* and then under the name of *F. distichus,* now turns out to be neither the one nor the other, but a new species, which Harvey proposes to call *F. anceps.*"

James Backhouse, Esq., presented specimens of *Trichomanes radicans,* accompanied by the following note:—"I have much pleasure in forwarding herewith specimens of *Trichomanes radicans,* found by my father and myself in a truly wild state, in Carnarvonshire. The plant was remarkably luxuriant."

J. Stewart Hepburn, Esq. of Colquhalzie, near Crieff, presented the stock of a larch tree which had continued to grow for twenty-five years after the tree had been cut down.

Professor Balfour remarked that this might be owing to its roots being connected with those of a neighbouring tree by natural grafting.

Mr M'Nab recorded the flowering of the following plants in the Botanic Garden:—Jan. 26. *Nordmannia cordifolia;* Feb. 2. *Galanthus plicatus;* Feb. 4. *Leucojum vernum.*

10*th March* 1864.—Professor BALFOUR, President, in the Chair.

The following Gentleman was elected a Resident Fellow of the Society:—

JAMES WILLIAMSON, Esq.

The following Donations to the Society's Library were laid on the table:—

Proceedings of the Literary and Philosophical Society of Liverpool, No. 17.—From the Society.

Proceedings of the Royal Horticultural Society, Vol. IV., Nos. IV., V.—From the Society.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft, 1862.—From the Society.

Etudes sur la Géographie Botanique de l'Europe et en particulier sur la Végétation du Plateau Central de la France, par Henri Lecoq. Paris, 1859. 9 vols., bound.—From Arthur Abney Walker, Esq.

Quelques mots a propos des Aérolithes. Par Armand Thielens.—From the Author.

Die Hieracien der Schweiz, von Chr. Christener.—From the author.

The following donations to the Herbarium were announced:—

From A. Abney Walker, Esq.—Specimens of *Leuzea conifera*, *Aster pyrenæus*, and *Astragalus narbonensis*.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Professor Bennett—Specimens from Mentone of *Caulinia oceaniea*, fruit of *Platanus orientalis*, and cone of *Pinus pinea*.

From Dr R. de Gambleton Daunt—Specimen of wood from Brazil called Cabinna.

From Dr Argyll Robertson—Large bulb of Squill.

From Messrs T. and H. Smith, chemists—Mannite from *Aconitum Napellus*.

The following Communications were read:—

I. *New Researches on Hybridity in Plants.* By M. Ch. Naudin. Translated from the Annales des Sciences Naturelles, by George May Lowe, Esq.

(1.) *On the Sterility and Fecundity of Hybrids.*

A century ago, Kœlreuter demonstrated by proofs which no other observer has ever surpassed in exactitude, and which still retain all their value, the fact of the sterility of hybrids being absolute in some cases, but only partial in others. These two facts, since so frequently confirmed, cannot now be disputed. In a former paper I gave some examples which serve to illustrate them.

We have seen *Nicotiana-californico-rustica*, *N. glutinoso-macrophylla*, *N. glutinoso-angustifolio-macrophylla*, *Digitalis luteo-purpurea* and *Ribes Gordonianum*, sterile both by the stamens and ovary—the former being totally destitute of pollen well formed, and the latter incapable of impregnation by the pollen of the parent plants. But as the pistil does not in every case present any appreciable deformity, it is natural to seek in the ovule itself the true cause of this inaptitude to receive impregnation.

It has been fully proved by many cases of hybridity, in which, in the same ovary one portion of the ovules resists impregnation, whilst the other becomes converted into embryonic seeds capable of germinating—that this defectiveness exists in the ovule, and not in the more exterior parts of the pistil.

We have seen this in the three hybrid generations of *Luffa acutangulo-cylindrica*, also in *Luffa amaro-cylindrica*, *Cucumis Meloni-trigonus*, *Nicotiana rustico-paniculata*, and *paniculato-rustica*, &c. *Cucumis myriocarpo-Figarei* is a not less convincing proof, since among 100 fruits which were developed and ripened under the influence of pollen derived from the maternal species, 19 at least were destitute of seeds, and each fruit, among the small number which contained any, only yielded one seed. I might mention, in support of this fact, the example of *Mirabilis longifloro-Jalapa*, though in this case the ovary is uniovular. The stigmas of this hybrid were all equally developed, and in

this respect not inferior to those of the parent species ; yet eleven attempts to impregnate it with the pollen of *Mirabilis longiflora* were made without effect, and even ten were necessary with that of *M. Jalapa* to determine the increase of a single ovule. In the *Luffa* hybrids just mentioned, and also in the case of *Cucumis Meloni-trigonus*, however poor the pollen might have been which was employed to fertilise their ovaries, it is beyond doubt that the number of good grains deposited on their stigmas far exceeded that of the ovules which were developed into seeds.

This, it is true, is only hypothetical, but it is extremely probable. It remains to be confirmed by the anatomical examination of the ovule, and it would be very interesting to discover in what part the defectiveness exists; but this is a peculiar kind of research, very difficult, very minute, often uncertain in its results, and which one cannot enter upon without being well accustomed to it, and provided with excellent instruments, two things in which I am deficient.

I therefore contented myself with verifying experimentally the fecundity or the sterility of the ovaries, which was more expeditious, and probably more conclusive ; but it is not less a subject to be recommended to professed micrographers.

That the sterilising action of hybridisation exerts much more force on the pollen than on the ovules is a most indubitable fact, and one well known to all hybridologists. This need not surprise us, since the pollen is, of all parts of the plant, the most elaborated, the most animalised, if such an expression can be used. Frequent chemical analyses prove that it is in these granules that the phosphorised and azotised materials are more accumulated than elsewhere, and thus it may be conjectured that it is this high organisation which is injured in hybrids, where the whole vegetation suffers from the disturbance which results from the intermixture of two specific essences created to live separately. The hybrids of which I have given an account present several examples. We have seen that *Mirabilis longifloro-Jalapa* yields pollen unfit for fertilisation, whether it be applied upon the stigmas of the hybrid, or upon those of its two parents, whilst in twenty-one attempts to impregnate it with the pollen of these last (*M. longiflora*

and *M. Jalapa*), there was only one which took effect, and enlarged the ovary. This result is quite in accordance with those which M. Lecoq ("Revue Horticole," 1853, pp. 185 et 207) announced that he obtained from the same hybrid, the pollen of which he always found useless, but he was able to fertilise it by that of *M. Jalapa.* The difference in the strength of the pollen and the ovules becomes still more manifest in *Nicotiana glauco-angustifolia* (and it would undoubtedly have been the case with *N. glauco-macrophylla* if the experiment had been made on it), where the whole pollen mass is defective and inert, whilst the ovary becomes filled with seeds, when it is fertilised with the pollen of *N. Tabacum* and *N. macrophylla.*

All the hybrids I have observed, containing well-developed grains of pollen in their anthers, have been fertile, often to a high degree, by their ovaries. I have never seen, and I do not believe it possible to mention a single instance in which, the ovary being sterile, the stamens have been fertile, even in the least degree.

The deleterious influence which hybridisation exercises upon the fertilising apparatus shows itself in different forms.

The most common, or at least the most remarkable case, is the direct atrophy of the pollen in the anthers, more rarely the atrophy of the anthers themselves; but we have also seen it act on the entire flowers. It is so among all the hybrids produced by the agency of *Datura Stramonium*, the flowers in the lowest branches invariably fall without opening; also among all the individuals of *Luffa acutangulo-cylindrica* of the first generation,—all the primary male flowers perish entirely, and also some flowers which begin to open when the plants are more than full grown, and have lost part of their vigour. The same phenomenon is observed in *Mirabilis longifloro-Jalapa*, which loses three-fourths of its buds, in *Nicotiana rustico-paniculata* and *paniculato-rustica* of three consecutive generations, &c. In fine, another mode of sterilisation is that effected by the changing of monœcious male flowers into female, as we have seen in *Luffa* hybrids of the third generation.

I have every reason to believe, although I cannot positively affirm so, that the specimen of *Cucumis Figarei*,

so remarkably large, and peculiar by the nearly total absence of male flowers, which I experimented on in 1856, and which yielded the results I have mentioned, owed both its great size and almost female unisexuality to hybridisation.

(2.) *On the Difference of the Fertility of Hybrids.*

Hybrids are self-fertile in all cases in which their anthers contain well-organised pollen; but if the quantity is very small, it is well not to leave the impregnation to chance, but to aid artificially in fertilising the hybrid with its own pollen. I have done this in *Luffa acutangulo-cylindrica* of the first generation, which has but few male flowers and a small quantity of good pollen.

In the majority of cases microscopic inspection sufficiently shows the character of the pollen; the difference in form, size, and transparency distinguishes the good and bad; and it is easy to judge, at least approximatively, of the relative quantity. Yet there are some cases, though not very common, where this examination of the pollen is not sufficient to determine whether it is active or inert; for it may happen that it has all the appearance of good pollen without having its qualities. Such was that of *Mirabilis longifloro-Jalapa*, whose grains, although unequal, were not deformed, and appeared full of fovilla, notwithstanding their inefficacy upon the stigmas of the two parent plants, as well as upon those of the hybrid. Perhaps the employment of chemical reagents would better determine their impotency.

There are various degrees of fertility in hybrids by means of pollen. We have seen *Luffa acutangulo-cylindrica* of the first generation extremely low in this respect, but in the third remarkably productive. It is the same, and nearly to the same degree, in *Luffa amaro-cylindrica*, *Nicotiana rustico-paniculata*, and *paniculato-rustica*, and in a great number of the toad-flax hybrids (*Linaria purpureo-violacea*) of the second, third, fourth, and fifth generations.

A greater richness of pollen is seen in *Primula officinali-grandiflora* of the first, and especially second, generation, and in *Cucumis Meloni-trigonus*, &c. In fine, there are some

hybrids where the pollen is little inferior, if at all, in perfection to the most legitimate species. This is the case in *Coccinia Schimpero-indica*, *Datura meteloido-Metel*, *D. Stramonio-Metel*, *D. Stramonio-lævis*, *Nicotiana angustifolio-macrophylla*, *N. texano-rustica*, *N. persico-Langsdorffii*, *Petunia violaceo-nyctaginiflora*, &c.; and the same in many of the toad-flax hybrids of the third and fourth generations, already very close to *Linaria vulgaris*.

In a word, as I said at the commencement of this article, hybrids are found of all degrees of fertility, from the extreme case where the ovary only is fertile to that where all the pollen is as perfect as that of the best-established species.

(3.) *Is the Aptitude of Species to cross each other, and the Fertility of the Hybrids which result, proportional to the apparent Affinity of the Species?*

In general this is the case; but there are exceptions, and we have stated some. There are, indeed, some species, closely allied in exterior organisation and physiognomy, which are less disposed to mutual crossing than other species which are far distant in their outward appearance. Thus we have seen three species of eatable gourds, so closely resembling each other that most botanists fail to distinguish them, resist all attempts to cross them; whilst the melon and *Cucumis trigonus*, so very different from one another, easily give origin to very fertile hybrids, though the pollen is a little defective. Such is the case with *Nicotiana glauca*, which, although very distant from *N. angustifolia* and *macrophylla*, yet gives hybrids with them, having very fertile ovaries; whilst *N. glutinosa*, more difficult to cross with them, although belonging to the same section of the genus, only gives one sterile hybrid both by the pollen and ovary. I might also mention the crossing of *D. Stramonium* and *D. ceratocaula*, two species strangers to each other, from which there results a fertile hybrid, although attended by that peculiar kind of partial sterility which consists in the loss of the first flowers.

These exceptions, for which it is probably impossible to assign a cause, do not prevent the affinity of species, as revealed by the exterior organisation, from indicating generally

the degree of aptitude to cross, and do not prevent us from forming a conjecture to a certain extent as to the fertility of the hybrids. We have seen the proof in *Datura Meteloido-Metel*, *D. Stramonio-Tatula* and *Tatulo-Stramonium*, *D. Stramonio-lævis*, *Nicotiana texano-rustica* and *rustico-texana*, *N. angustifolio-macrophylla*, &c., which hybrids, with the marked exception of those of *D. Stramonium*, have perfect fertility. The aptitude of species for mutual impregnation, and the degree of fertility of the hybrids which result, are therefore the true signs of their special affinity as regards generation; and in the great majority of cases this affinity is indicated by the exterior organisation—in other words, by the physiognomy of the species.

(4.) *On the Physiognomy of Hybrids.*

To give a just idea of the aspect which hybrids present, it is essential to distinguish between the first generation and those which follow.

I have always found in those hybrids which I have obtained myself, and whose origin has been well known to me, a great uniformity of aspect between individuals of the first generation, no matter how numerous, provided they proceed from the same crossing. This we have seen in *Petunia violaceo-nyctaginiflora*, *Datura Tatulo-Stramonium*, and *D. Stramonio-Tatula*, *D. Meteloido-Metel*, *D. Stramonio-lævis*, *Nicotiana texano-rustica*, and *N. rustico-texana*, *N. persico-Langsdorffii*, &c.

I do not mean to say that all the individuals of the same crossing are absolutely counterparts of one another; there are sometimes slight variations between them, but not sufficient to alter the general uniformity in a sensible degree, and it does not appear to me that these differences are any greater than those which are frequently seen between the seeds of legitimate species of the same production. In short, it may be said that hybrids which proceed from the same crossing, resemble each other, in the first generation, as much as, or nearly as much as those which proceed from the same legitimate species.

Must it be admitted, as M. Klotzsch maintains, that mutual hybrids (those which proceed from the two possible

crossings between the two species) are markedly different from each other; for example, the hybrid obtained from the species A fertilised by the species B, differs sensibly from that which is obtained from the species B fertilised by the species A? I cannot deny this in an absolute manner; it would be necessary to see the hybrid which induced M. Klotzsch to make this statement; but I can assert, that all the mutual hybrids which I have obtained, as well between allied species as between distant ones, resembled one another as much as if they proceeded from the same crossing. I have already pointed this out when speaking of *Datura Stramonio-Tatula* and *Tatulo-Stramonium*, *Nicotiana paniculato-rustica* and *rustico-paniculata*, *N. angustifolio-macrophylla* and *macrophyllo-angustifolia*, *N. texano-rustica*, and *rustico-texana*, *N. persico-Langsdorffii*, &c.; without doubt it may not be always so, but if the fact is true, it must be rare, and considered more as the exception than the rule.

All hybridologists are agreed that hybrids (and it always applies to hybrids of the first generation), are mixed forms, intermediate between two parent species. And this is really what does take place in the great majority of cases; but it by no means follows that these intermediate forms are always at an equal distance between the two species. On the contrary, it is often observed that they are frequently much nearer one than the other. Besides, we may conceive, that the appreciation of these relations is always a little vague, and that it is the idea which determines it. We may also remark that hybrids resemble sometimes one of the two species in one character, whilst they resemble the other in another character. This is very true, and we have seen an example in *Mirabilis longifloro-Jalapa*, which is distinctly more like *M. longiflora* in the organs of vegetation, and *M. Jalapa* in the flowers. But I think it is wrong to refer this distribution to the part which the species have played as father or mother in the crossing whence the hybrid has arisen. At least I have not seen anything which confirms this opinion.

M. Regel asserts (*Die Pflanze und ihr Leben*, &c., p. 404, *et suiv.*), that when the hybrid proceeds from species of different genera, their flowers bear the essential characters of

those of the father; but we have seen in the *Datura cerato-caulo-Stramonium*, proceeding from two nearly generically different species, the flowers were absolutely like those of the mother (*D. Stramonium*) ; in *Nicotiana glauco-angustifolia*, and *glauco-macrophylla* obtained from very different species, they were remarkably more like those of the mother than those of the father; whilst in *N. californico-rustica* and *glutinoso-macrophylla* they were very distinctly intermediate between the parent species.

The rule laid down by M. Regel seems to me therefore very hazardous, or at least founded upon insufficient data. For my own part, I believe that these inequalities in resemblance, sometimes very great between the hybrid and its parents, are maintained chiefly by the marked preponderance which many species exercise in their crossings, whatever may be the part which they act (whether as male or female).

This we have seen in the hybrids of *Petunia violacea* and *P. nyctaginiflora* which have a greater resemblance to the first than the second; in *Luffa acutangulo-cylindrica* of which the forms are far more like *Luffa cylindrica* than the conjoined species; and especially in *Datura ceratocaulo-Stramonium* and *D. Stramonio-lævis*, of which all the individuals are incomparably nearer *D. Stramonium* than the other species, although in one case *D. Stramonium* fulfils the function of the male, and in the other that of the female.

Commencing with the second generation, the physiognomy of hybrids is modified in a most remarkable manner. Very often the perfect uniformity of the first generation is succeeded by an extreme medley of forms, the one approaching the specific type of the father, the other that of the mother—sometimes returning suddenly and entirely into the one or the other. At other times this recurrence towards the generating types is performed by degrees and slowly, and sometimes the whole collection of hybrids is seen to incline to the same side.

I think it is now placed beyond dispute that this dissolution of hybrid forms commences, in the great majority of cases (it may be in all) in the second generation.

(5.) *On the return of Hybrids to the specific forms of the producing species. What is the cause which determines this return?*

In every hybrid which I have examined, the second generation presented changes of aspect, and a manifest tendency to return to the forms of the producing species, and that under such conditions that it was impossible for the pollen of those species to have concurred in bringing them back. We have seen striking examples in *Primula officinali-grandiflora*, in all the hybrids of *Datura Stramonium*, *D. Meteloido-Metel*, the mutual hybrids of *Nicotiana angustifolia* and *macrophylla*, *N. persica*, and *Langsdorffii*, *Petunia violacea* and *nyctaginiflora*, in *Luffa acutangulo-cylindrica*, and still more in *Linaria purpureo-vulgaris*. Among many of these hybrids, from the second generation, a complete return to one or other, or even both, of the two parent species has been seen, and approaching them in different degrees; among many also we have observed forms continuing intermediate, whilst simultaneously other specimens of the very same production have effected the return of which I am about to speak. Further, we have stated in some cases (*Linaria purpureo-vulgaris*) that, in the third and fourth generation, true retrogression towards the hybrid form takes place; and sometimes even we have seen individuals of a plant to all appearance wholly returned to one of the two species, which seemed to revert almost entirely into the opposite species.

All these facts are naturally explained by *the disjunction of the two specific essences in the pollen and ovules* of the hybrid. A hybrid is an individual in which two different essences are found united, each having its particular mode of vegetation and finality, which are mutually opposed, and are constantly striving to disengage themselves from one another. Are these two essences intimately blended? Do they reciprocally penetrate every part, so that each particle of the hybrid plant, however minute or divided, contains equal portions of both?

It may be so in the embryo and first stages of the development of the hybrid; but it seems to me more probable that

this last, at least in the adult state, is an aggregation of particles, both homogeneous and unspecific when taken separately, but distributed more or less equally between the two species, and mixed in different proportions in the organs of the plant. The hybrid, according to this hypothesis, would be a living mosaic, the discordant elements of which, so long as they remained mixed, would be undistinguishable to the eye; but if, in consequence of their affinities, the elements of the same species approached each other and agglomerated themselves in small masses, parts and sometimes entire organs, would then be visible, as we have seen in *Cytisus Adami*, and the bizarre group of the orange and citron hybrids, &c. It is this tendency of two specific essences to disengage themselves from their combination, which has induced some hybridologists to say, that hybrids resemble the mother by their leaves and the father by their flowers.

Although the facts may not be sufficiently numerous to conclude with certainty, it seems that the tendency of species to separate, or, so to speak, to localise themselves in various parts of the hybrid, increases with the age of the plant, and is more and more pronounced as the vegetation approaches its term. These disjunctions become more manifest in the highest organisms of hybrids, about the reproductive organs; in *Cytisus Adami* disjunction shows itself in the flowering branches; in the orange anomalies and *Datura Stramonio-lævis* in the fruit itself. In *Mirabilis longifloro-Jalapa* and *Linaria purpurea* the corolla manifests the phenomenon of disjunction, by the separation of the colour peculiar to the producing species. These facts authorise the idea that the pollen and ovules, but especially the former, are precisely the parts of the plant where disjunction goes on with most energy; and what adds a greater degree of probability to this hypothesis is, that they are at the same time very elaborate and minute organs—a double reason for rendering the localisation of the two essences more perfect. This hypothesis being admitted, and I confess it seems to me extremely probable, all the changes which supervene in hybrids of the second and more advanced generations would explain themselves, as it were;

but if, on the contrary, it be not admitted, they would be perfectly inexplicable.

Let us suppose in the Toadflax hybrid of the first generation, that disjunction takes place both in the anther and contents of the ovary; that some grains of pollen entirely belong to the paternal species, others to that of the mother; that in others disjunction has not, or, at least, only just commenced. Again, let us suppose that the ovules are, to the same degree, separated both in the direction of the male and female parent; what will result when the pollen tubes descend into the ovary to fertilise the ovules? If the tube of a pollen grain, which has returned to the male parent, meet an ovule separated in the same direction, *a perfectly legitimate* fecundation will be produced, from which will result a plant entirely returned to the paternal species. A similar combination effected between a pollen grain and ovule, both returned to the female parent, the product will return in the same manner to the species of this last; if, on the contrary, combination is effected between an ovule and pollen grain, separated in opposite directions, they will perform a true crossed fecundation, like that which gave origin to the hybrid itself; and there will again result a form intermediate between two specific types. The fertilisation of an ovule non-separated, by a pollen grain separated in either direction, would give a quadroon hybrid; and since disjunctions, as much in the pollen as in the ovules, can take place in all degrees, every sort of possible combination will result as chance may direct. We have seen these multitudinous forms produced in the Toadflax hybrids, and *Petunia* from the second generation.

The retrogression of a hybrid in its course of return to one of the parent species is also easily explained by this hypothesis. I mentioned several examples when speaking of the third generation of *Linaria purpureo-vulgaris.* Thus, for example, among eighty plants sprung from an individual of the second generation, which seemed to be entirely returned to *L. purpurea*, fresh hybrids appeared, which came back to the intermediate form of the first hybrid, and other individuals still more sensibly approached to *L. vulgaris.* The reason is, that the purple-flowered hybrid of

the second generation, notwithstanding appearances, still retained some essence of the yellow-flowered Linaria, and this strange particle was sufficient to bring some pollen grains and ovules back either to a mixed state, or altogether to *Linaria vulgaris.*

Similar actions are produced, though less marked, in the descent of hybrids of the second generation, which seem entirely returned to the type of *L. vulgaris*, and even to a certain extent in that of *Datura Stramonio-lævis,* where some individuals return to *lævis*, preserving up to the third generation the accessory characters which belong to that form of hybrids. All these facts show us that the separation of specific forms allied in hybrids, is not always completed so rapidly as one might be led to suppose, judging from physiognomy and external appearance.

The return of hybrids to the forms of the parent species is not always so sudden as that which we have observed in the Primroses, Petunias, *Linaria purpureo-vulgaris*, *D. Meteloido-Metel*,&c.; it is frequently completed by insensibly minute gradations continued through long series of generations. We have seen, for example, in *Luffa acutangulo-cylindrica*, even in the third generation, that among forty individuals only one was found which had wholly reassumed the external appearance of *L. cylindrica.*

Hybrids of *Nicotiana persica* and *Langsdorffii*, modify themselves slowly, and ten or even more generations may be insufficient to bring them back entirely to the specific forms.

It is remarkable in the latter case, that the hybrids do not present any appreciable mark of disjunction of the two specific essences, which appear intimately blended together in every part of the plant. Nevertheless the traits of one of the two species sensibly disappear from generation to generation, as if extinguished by degrees; but it not unfrequently happens that this extinction takes place with such rapidity as to be completed in the second generation.

En résumé, hybrids fertile and self-fertile return sooner or later to the specific types from which they were derived, and this return is effected either by the separation of the two mixed essences, or by the gradual extinction of one of

the two. In the latter case the hybrid posterity returns entirely and exclusively to one only of the two producing species.

(6.) *Are there any exceptions to the law of return of hybrids to the parent forms? Do certain hybrids become fixed and give rise to new species?*

I have not been long enough engaged in the study of hybrids to have formed any settled opinion on this question. Many botanists of good authority believe that some hybrids, if not all, *can* become fixed and pass to the state of constant varieties, that is to say, true species, intermediate between those of their parents; this is in particular the opinion of M. Regel, who regards it as probable that in the group of willows, roses, and many other genera rich in nearly allied forms, the nomenclature of which is very embarrassing to the botanist, there originally existed but a small number of species (two or three), the fertile crossings of which have given rise to equally fertile hybrids, which, in their turn, crossing between themselves and their parents, have produced, age after age, those multitudes of forms which exist at the present day.

Such may be the case, but it is without proof, and the hypothesis is entirely gratuitous. In my opinion the fact may be explained otherwise in a much more natural and probable manner, viz., by the inherent property of all organisms (at least vegetable) to modify themselves to a certain extent according to the influence of the surrounding medium, in other words, by the innate tendency of what we call *species* to subdivide into secondary species. How can it be admitted, for example, that roses, which are disseminated over the whole extent of the Old World, from Ireland to Kamschatka, from the Atlas and Himalayas to the glacial ocean, which cover all North America, which are often isolated in narrow spaces and different localities, can have met each other to give rise to hybrid forms?

It would be hardly possible to conceive such a fact. Have roses never been subjected to experiment to ascertain how far they can mutually hybridise, and if their hybrids

would be fertile or not? I can affirm this, that I have never obtained a hybrid which manifested the least tendency to form a specific stock.

At present I only know a single instance which might serve as a basis for the hypothesis of fixation of hybrids. Still this fact is doubtful; it is that of Ægilops, closely allied to wheat, which was cultivated at the Museum about ten years, during which the successive generations did not produce any appreciable modification.

It remains to be proved whether the Ægilops cultivated at the Museum (*Æ. speltæformis*, Jord.) is really a hybrid, and that it does not modify itself during a long series of generations: it would be an exception; but this very general rule would not be weakened, at least so long as the fact remained isolated.

(7.) *Is there any precise limit between Hybrids and Crosses?*

Most hybridologists insist on making a distinction between hybrids and crosses, and nothing could be more easy to understand; the hybrid results from the crossing of two distinct species, two true species, as M. Regel says—the crosses from that of two races or varieties.

Theoretically, nothing is more clear; in practice, nothing is more difficult than the application of these two words.

For example, ought the produce obtained by the crossing of the Cantaloup Melon and Netted Melon, that of the Netted Melon and Dudaim, that of Dudaim and *Cucumis Pancherianus*, or even that of *Datura Stramonium* and of *Datura Tatula*, &c., to be called hybrids or crosses? This question gives rise to another, that of the distinction of species, races, and varieties, an everlasting subject of dispute among naturalists, which too often ends in a war of words unworthy of the science; to settle which, it is necessary to turn to the examination of what is understood by the term *Species*, *Race*, and *Variety*.

(8.) *What, therefore, is a Species, Race, and Variety?*

Let us start at the very origin of the notion of species,

and not lose sight of the fact that all our ideas arise from the *contrast of things.*

The man blind from birth has no idea of darkness, because being deprived of the sensation of light he does not perceive the difference between the two ; even one possessed of sight would have no idea of the light which surrounds him if the whole world was luminous and that to the same degree. The notion of species does not escape the common law ; it is more complex, and is formed from more elements, as we shall attempt to elucidate.

If there existed in nature but *one vegetable form*, wheat for instance, always and everywhere alike, without any variation in the innumerable individuals which represent it, we might arrive at the idea of an *individual* and *vegetable*, but not *species ; wheat* and *vegetable* would be confounded in one's mind as one and the same thing.

Let us suppose also that nature had created an indeterminate number of different organisms, and each of them represented on the earth by only a single individual, incapable of multiplying itself, but indestructible and imperishable ; even here we could not arrive at the conception of a species, for each type of organisation would be isolated, and have no resembling individual.

To have a species it is necessary, therefore, 1*st*, To have a *plurality* of similar individuals, that is to say, a group, a collection ; 2*d*, That this group or collection of individuals *contrast in some degree* with other groups of individuals likewise resembling each other, and yet able to approach one another in some common points which render them comparable.

It follows that the idea of species is connected with that of kind or genus (I mean genus taken in a philosophical sense) ; that the one fact always supposes the other ; that, in a word, they are inseparable and unable to exist apart. And as, in the organic world, individuals have a transitory existence, reproducing themselves by generation, it is necessary, 3*dly*, In order that species may have consistence and duration—that the *resemblance of individuals forming a specific collection shall continue in successive series of generations.*

Thus a plurality of similar individuals forming a group, and the contrast of groups among themselves by certain

characters common to different groups; and, *lastly*, The perpetuation of resemblances between the individuals of the same group constitute the elements of species. Species contain nothing more or less.

It is not, therefore, an ideal type, as certain abstract-loving naturalists have suggested; it is essentially a collection of similar individuals. The abstract ideal type of a common organisation is only, as it were, a tie, which in our mind collects similar individuals in the same bundle, and sums up the contrasts (or differences) which separate their group from every other.

It is necessary, then, to return to the pure and simple definition of Cuvier,—viz., *A species is a collection of individuals descended from one another, or from common parents, and from those which resemble them as much as they resemble themselves.*

Let us remark, in passing, that in thus defining species, Cuvier did not take *races* and *varieties* into consideration.

Everywhere where there is a group of similar individuals, contrasting in some measure with other groups, and preserving through a series of generations the physiognomy and organisation common to all the individuals,—*there is a species.*

It is by their contrast that species are distinguished from one another, and it is by comparison that their contrasts appear. Contrasts may be more or less great according to the objects compared. If they are very great and well marked, all the world acknowlege the specific distinction of the compared forms; if they are very weak, almost inappreciable, opinions are divided; one party separating the feebly contrasting forms into distinct specific groups, the other collecting them into one, and applying to them in the mean time the qualifications of *races* or *varieties.*

These collections and separations are purely optional, and they can have no other rule than scientific or economic advantage; in order to determine them it is necessary to be endowed with a certain tact which is ordinarily acquired by experience.

In short, there is no qualitative difference between species, races, and varieties; it is idle to seek one. These

three things are formed from one, and the terms which pretend to distinguish them only indicate degrees of contrast between compared forms.

It must be understood that here the question is not concerning simple individual variations, non-transmissible by way of generation, but only forms common to an indefinite number of individuals, and transmitting themselves faithfully and indefinitely by generation.

Contrasts between compared forms *are of all degrees*, from the strongest to the weakest, which simply means that following the comparisons which are established between groups of similar individuals, species are found of all degrees of strength and weakness; and if it was attempted to express these degrees in so many words, the whole vocabulary would be insufficient.

The delineation of species is therefore as I said before entirely optional; it makes them larger or smaller, according to the importance which is given to the resemblances and difference of various groups of individuals taken with respect to each other, and these appreciations vary according to men, times, and phases of science. How many modifications have certain great species of Linnæus and Jussieu undergone during fifty years!

The division of old species, their *pulverisation*, if I may use such a term, seems to have now reached its extreme limits, and many botanists are led by this tendency to complicate the descriptive part of the science in such a way as to threaten to involve the whole life of a man in its minutiæ. Notwithstanding this, if those who have inaugurated these scientific refinements have not committed error by taking individual alterations, non-transmissible and not forming a group, that is to say simple variations, for forms common to an indefinite number of individuals, very constant and very faithfully transmissible in every consecutive generation, there is reason to believe that they have proceeded logically. The whole question is to know if it be advantageous to science to distinguish and enrol in its catalogues, these feebly contrasting species; but it is essentially necessary to be assured that the characters which are assigned them are really specific— that is to say, common to an unlimited num-

ber of individuals, and always faithfully reproduced in every generation.

But it is more than probable that in a multitude of cases (in the genus *Rubus*, for example) purely individual variations without persistence, have been taken for common characters, constant and transmissible.

Does it then follow that the terms *race* and *variety* ought to be banished from the science? Certainly not, for they are convenient to designate weak species that ought not to be enrolled among the official species, but it is proper to give them their true signification, which is absolutely the same as that of *species* properly so-called, and to see in forms designated by these terms some unity of a weak kind, which might be neglected without inconvenience to the science.

(9.) *Can Artificial Hybridisation furnish a mark to determine what it is proper to distinguish as Species?*

I have not the least doubt but that there are some cases where it would be of a slight assistance, and again a greater number where it would not be practicable. Here are some examples of its practical utility.

I have stated before, in speaking of the three species of eatable gourds, that they but slightly differ in outward appearance, and even by their intimate characters, for most botanists cannot clearly distinguish them; Linnæus himself confounded them in one. But these three plants refuse to give hybrids by mutual crossing; they are then three self-governed species perfectly distinct.

M. Dunal, in his Monograph of Solanaceæ, combines into one species *Datura Stramonium* and *D. Tatula*, considering them as simple varieties of the same species. But the produce of their crossing does not vegetate altogether like these two forms; it grows much larger and flowers less, inasmuch as it loses its flower-buds in the seven or eight first branches. This disturbance caused in the vegetation of the mixed produce, is an indubitable sign of a difference in the autonomy of the two parent forms; therefore these forms ought to be held as distinct species.

Datura Metel and *Meteloides* are at least as nearly allied

to one another as the two preceding; but, from the second generation, their hybrids cease to resemble them, and a certain number of individuals return to one or other of the two parent forms. Let us therefore conclude that these forms are specific, that they each have their autonomy and deserve, notwithstanding their affinity, to be distinguished from one another.

Nicotiana macrophylla and *N. angustifolia* combined in the "Prodromus" of De Candolle with *N. Tabacum*, give hybrids which, after the second generation, manifest a very appreciable commencement of return towards the producing forms. These last have therefore also their manner of growth proper to each of them. Why do we not admit them as distinct in our botanical catalogues?

But when the forms are so closely allied to one another that they are with difficulty distinguished, their hybrids must differ still less from one another than they differ between themselves. The data furnished by hybridisation, therefore, here lose their value; but then it becomes a matter of indifference, whether to separate the two forms as distinct species, or to combine them, by the title of simple varieties, under a common specific denomination.

It follows from all we have said, that the application of the terms hybrid and cross is determined by the rank which may be assigned to the individuals from the crossing of which the mixed forms requiring to be named have been produced—that is to say, it is entirely left to the judgment and tact of the nomenclator.

II. *On the Chemical and Natural History of Lupuline.* By M. J. Personne. Translated by George Lawson, LL.D., Professor of Chemistry in Dalhousie College, Halifax, Nova Scotia. (Plate II.)

Note by Translator.—Considering the great importance of the hop in an economical point of view, we might expect our scientific and manufacturing works to contain a somewhat satisfactory statement of the chemical products of the hop, and of the nature and development of the remarkable organ by which these products are secreted. This, however,

is far from being the case; and intelligent brewers in Canada, puzzled by the contradictory statements that have been put forth, have frequently applied to me for information on this as on other scientific points connected with their art. I have therefore thought that a translation of M. Personne's Memoir, published some years ago in the "Annales des Sciences Naturelles," might not be without its use. In some of its bearings, the subject is of much interest in a strictly scientific point of view. It is obvious, likewise, that an acquaintance with the chemical properties of Lupuline is important, not only to the brewer, but to the hop-grower, the exporter, the manufacturer of hop-extract, and, indeed, to every one who has to handle an article so prone to change its character, and, consequently, its commercial value, from apparently trifling causes. The Canadian brewers having a favourable grain-market, and an unlimited supply of excellent water in the great lakes, almost entirely devoid of organic matter, have the means of manufacturing excellent beer. But much of the hops used requires to be imported from England. Canadian hops are grown to some slight extent at Kingston, more abundantly about Picton, and Belleville, C. W., and especially farther to the westward; but the best qualities of hops are always imported. The Canadian hop gives greater bitterness, but is deficient in delicacy of aroma. Were pains taken (and I have reason to believe that hitherto they have not been taken) to select suitable varieties from the Kentish hop-gardens, and to ascertain, more precisely than we as yet know, what are the special influences of certain soils and climates, no one can doubt but that a great improvement would result in the character of Canadian hops. All attempts in this direction must proceed upon a correct knowledge of the nature of the substances which give the hop its economical value; and although M. Personne's memoir is more complete and satisfactory than any other that has been published, yet it is to be hoped that by again calling attention to the subject, additional information may be obtained on points that are still imperfectly made out.

The cones of the hop (*Humulus Lupulus*) employed in

therapeutics, and especially in the manufacture of beer, owe their properties to a multitude of yellow corpuscles, resinous and odorous, which are separated very freely in bruising the ripe and dry cones. These small bodies have been successively called by the names of Lupulin, Lupuline, and Lupulite. It is to these that the hop owes its bitter and aromatic flavour; for if the scales and the fruit are deprived of this yellow powder, the cones lose those properties on account of which they are sought after.

The importance of this substance has been known for a sufficiently long time. In 1821, Dr Ives of New York attempted to determine its principal constituents, and endeavoured to introduce it into therapeutics under the name of Lupulin. In France, almost about the same time, Planche likewise concluded that it was a proximate substance, and named it Lupuline, because, said he, "This substance is to the hop what quinine is to cinchona or strychnine to nux-vomica."

In 1822, MM. Payen and Chevallier made the most complete chemical analysis which we have of this substance. They thereby demonstrated the complex nature of lupuline, and, consequently, the error of Planche; but the small quantity of substance upon which these chemists worked, did not permit them to study sufficiently well the bodies which they had obtained from it.

Lastly, in 1827, M. Raspail published, on the organisation of lupuline, the unique work which exists on this subject. That author sought to demonstrate the analogy of this body with the pollen, as much by the investigation of its structure as by that of the action which the various solvents and chemical reagents exercised upon it. He designated it under the name of *pollen of the foliaceous organs*, "because its office," said he, "is to fecundate the bud, just as that of the pollen of flowers is to fecundate the ovary." I review farther on the observations of M. Raspail.

Structure and Development of Lupuline.

The lupuline obtained from cones that have arrived at maturity presents itself in the form of a yellow powder, whose tint varies according to the length of time which has elapsed since it was gathered. In the fresh state, it

has a greenish-yellow colour, which afterwards passes into a golden yellow, deepening more and more the longer it is kept, especially when exposed to contact with air. The form of the lupuline, when it has arrived at its complete development, may be compared to that of an acorn with its cup. Just as some acorns are more or less lengthened at the base, so also some of the grains of lupuline are more or less elongated. The length of these grains varies between $\frac{16}{100}$ths and $\frac{30}{100}$ths of a millimetre, and their thickness between $\frac{14}{100}$ths and $\frac{26}{100}$ths; but in general the two parts of the lupuline, the superior and inferior, are strictly proportional. We shall later see the reason.

In comparing the lupuline with an acorn, I do not mean to say that it is, like it, composed of two solid parts, one of which encloses the base of the other. The comparison can only be applied to the external form, for they differ in all other respects. In fact, the surface of the two parts, superior and inferior, of the lupuline, is perfectly continuous, only the superior, at its point of insertion on the inferior, is bent a little inwards towards the centre, and it is the slight curve which it makes that gives it the acorn form.

These two parts present on the exterior, even under a magnifying power of from 200 to 300 diameters, a structure apparently similar. Both appear to be composed of cellules more or less irregular, which, however, are frequently disposed with a certain regularity from the centre to the circumference; they are sometimes ranged in radiating series from the summit of the superior part, and from the base of the inferior to the circumference or median line, which unites them. The cells, therefore, increase in size from the two extreme points to the (median line) point of junction. But as I said just now, this structure is only *apparent* in the upper half; because if we succeed in making a longitudinal section in the direction of the axis of the grain of lupuline, and adjust the same, when placed under the microscope, in such a manner that the plane parallel with its axis shall be in the focus of the instrument, it will be seen that the lower half of the grain is a sort of cupule, composed of a single layer of cells. It is by the base of this cupule that the grain is attached to the epidermis of the bracts, calycine leaves, &c. It is observed, besides,

that the upper half consists only of a very thin continuous membrane, and that the cells, which are depicted upon its surface, are nothing more than the imprints of utricles, the origin of which we give further on in describing the formation of this organ, this singular gland. The space embraced between this membrane and the interior of the cupule is occupied by a yellow liquid, the nature of which we shall examine fully farther on. The cellules which compose the cupule are also filled; it is these that secrete it, as we shall presently see.

One sees already that this description of lupuline differs essentially from that given by M. Raspail in his "New System of Organic Chemistry," 1833, page 175. Here, in effect, is what he says:—"Examined by the microscope, this yellow powder (the lupuline) is seen to be composed of vesicular organs, rich in cellules, varying in size about the $\frac{1}{8}$th of a millimetre, and of about the form of that represented in figure 6 of plate v. (of his work.) Each of these grains, when dried, is of a beautiful golden yellow, somewhat diaphanous, flattened, presenting on some part of one of its two surfaces the mark of its point of attachment, by which the grain has been originally attached to the organ which produced it, which mark I usually designate by the name of hilum. . . . When these grains are examined, as recently obtained from the still living female cone, they are found to be pyriform, with a peduncle terminated by a hilum," &c.

And farther on, § 387, pp. 176, 177, M. Raspail attempts to prove that the grains of lupuline emit pollen tubes, and that these are produced in contact with water. The conclusion of this paper will show the cause of the error of this observer.

Let us now study the origin of lupuline.

It commences like a hair, by one cellule *l* (fig. 3, Plate II.), which is developed between cells of the epidermis *e*. This cellule, projecting to the exterior, is divided by a transverse partition at the level of the external surface of the epidermis. The utricle *a*, ovoid or elliptical, which results from this division, is in its turn divided transversely (fig. 4, *a*). The two new utricles enlarge; the superior *a* (fig. 5) is more dilated than the other, and is filled

with somewhat granular matter; the inferior *p* forms a short pedicel, which unites the former to the epidermis *e*, by means of the primitive cell *l*. Thus far the multiplication goes on by transverse division; it now proceeds vertically. The terminal cellule *a* divides longitudinally into two, as shown by figure 6 at *a*. Each of the two utricles which thus originate produces in its turn, either one after the other (figs. 7 and 9), or simultaneously (figs. 8 and 10), two cellules, so that by this time the pedicel *p* is terminated by three cells (fig. 7), or by four, as in figure 8. The figures 11 and 12 show more advanced stages of this subdivision. There now appear some new utricular elements in the interior of the terminal cells. Figure 13 presents a degree of multiplication still more advanced; in it may be clearly observed, in *a a a a*, the four terminal cells of figure 8, and that they have divided in a radial manner and parallel to the circumference. In figure 14, which indicates a later phase, may also be observed the four original divisions; but the cells of each of these are still more numerous than in the preceding figure. It not unfrequently happens that the utricular multiplication parallel to the rays is more marked than that which occurs in the other direction, in which case the section appears as in figure 15. It is at this stage of development of the lupuline that its edges become raised; then from the discoid state it becomes cup-shaped. Figure 16 represents some of these cupules which are almost arrived at the perfect state. They have longitudinal striæ, interiorly and exteriorly; that is to say, in the direction of the utricular multiplication parallel to the rays. These elegant cupules appear sessile in consequence of the pedicel not being elongated.

When the enlargement of the cups has ceased, other phenomena take place in the interior of their tissues. Each cupule consists, at this time, of a layer of cells, which is covered with a cuticle on its two faces, the interior and exterior; then commences the secretion of the yellow liquid before mentioned. It is poured out on the whole internal surface of the cupule between the secreting cells and the cuticle which covers them. The latter, detached from the cells by this flowing, is gradually raised completely from

the whole extent of the internal surface (fig. 17 *d*), and finally pushed up like the finger of a glove ; it is now that the lupuline takes the form of an acorn (figs. 18 and 19), to which I have compared it ; it is then arrived at its most perfect stage of development.

It is curious to observe under the microscope the rising of the cuticle. It may be caused artificially, by placing the cupules in water slightly alkalised, which penetrates their walls better than pure water. They may be seen successively passing through all the intermediate stages between the form *l* of figure 16 and that of figure 18.

If we examine the fresh but perfectly developed lupuline in water, it is seen to swell gradually, becoming turgid by endosmose, then all the cells of the cupule appear as a perfect network, and it is then evident that the imprints marked upon the cuticle disappear almost completely. The enlargement increases to the point of bursting of the grain, and it then emits a perfect cloud, formed by a multitude of small globules of essential oil ; it frequently happens that these globules, by uniting, form a globule somewhat large, which is very well seen on the summit of the grain in front of the rent.

This rent is generally made at the junction of the cuticle with the edge of the cupule. The cuticle is raised, as a cover, and, as the cupules open, the cuticle is detached, and swims away in the surrounding liquid. Occasionally during this action it occurs as much in the wall of the cuticle as in that of the cupule, according to their greater or less resistance.

An alkaline solution and alcohol act more rapidly than water, because, by dissolving more readily the resinous matter which impregnates the walls of the grains, they render the penetration more easy.

It has never been possible for me to observe the pretended pollen tubes seen by M. Raspail, in examining the fresh lupuline. But if we examine lupuline that has been kept for some time, we observe a very few grains which are with difficulty impregnated with liquid in this or that place, and which, breaking a long time after most of the others, permit the exudation of a viscid matter. This matter, moulding itself in the aperture which gives it passage,

slightly resembles, to a certain extent, a pollen tube, and it was this most probably that was seen by M. Raspail; but it requires only a slight examination to account for the appearance, which is most certainly due to the interior matter of the grains having been dried dissolving with difficulty.

The lupuline is produced on the ovaries, on the inferior surface of the bracts and on that of the leaves. It is equally met with on the stem and on the stipules; but it is only on the ovary and on the scales of the cone that the lupuline arrives at its complete development. On the leaves, on the stipules, and on the stem, it is never met with except in the state of cupules more or less advanced, or all simply of discs, which readily wither up and are shed.

The lupuline is then a gland, which contains a complex liquid, of which we now proceed to investigate the nature.

Chemical History of Lupuline.

The matter contained in the gland, which I designate by the name of *Lupuline*, has a very complex composition; its constituent principles may be classed into two groups: the one embracing those that are volatile, and are obtained by distillation with water; the other those that are fixed, or at least not volatile with steam.

Examination of the Volatile Principles.

The product of distillation consisted of a solution decidedly acid, which reddened tournesol paper, and upon which floated an essential oil, coloured occasionally of a most beautiful green.

The proportion between the quantity of essential oil and of acid of the liquor distilled varied according to the quality of lupuline employed in the operation. Besides, the lupuline when as fresh as possible, furnished at once a less acid liquor and a greater quantity of essential oil than the older lupuline, which gave, on the contrary, more acid and less essential oil; the latter is likewise drier and more resinous than that obtained with the freshest lupuline.

The quantities of essential oil which I obtained with the lupulines of different ages, have given me the following proportions :—With recent lupuline I obtained as much as

1 from 100 of the essence, while with older lupuline I have had not more than 0·61 from 100, that is near my proportion.

Volatile Acid of Lupuline.

If we next separate the essential oil from the acid liquid obtained, as I have described, by distillation of lupuline with water, and saturate the liquid with some carbonate of soda, and then evaporate to dryness, it yields as residue a mass of a soapy nature, which liquefies by heat and becomes very solid on cooling, it is with difficulty permeable by water, which, however, ultimately dissolves it completely; it, in short, comports itself like the compounds of fatty acids with alkalies.

This mass, dissolved in a small quantity of water and then treated with sulphuric acid diluted with its weight of water or with gelatinous phosphoric acid, yields some sulphate or phosphate of soda which remains in solution in the aqueous liquid, to the surface of which is seen to float a brown oily liquid, diffusing a strong and disagreeable odour of butyric and valerianic acids.

Subjected to distillation this liquid furnished, by many successive rectifications, a product which boiled at + 175 degrees (=347° Fahr.), and distilled without alteration at this temperature; the first portions carried over water in excess, which was thus separated with sufficient ease.

This acid, obtained in a state of purity, is a liquid, slightly oleaginous, very fluid, colourless, with a strong and persistent odour of valerianic acid; its flavour is acid and piquant; it produces a white stain on the tongue in the manner of energetic fatty acids; it is not solidified by a cold of −16 degrees (= +3°· 2 Fahr.), and remains perfectly limpid; it burns readily with a smoky flame. The specific gravity of this acid is found to be 0·9403 at + 15 degrees (=59° Fahr.). It corresponds to that of valerianic acid, which has been found to be 0·937 at + 16·5 (=61°·7 Fahr.)

I omit here the description of all the analyses which I have made for ascertaining the composition of this acid. All lead to the formula of valerianic acid. I have purposely multiplied its combinations with oxide of copper, oxide of silver and baryta, in order to be well satisfied of

its true constitution. But the odour alone of lupuline, especially of that which has been kept for some time, does not admit of doubt of the existence of this acid among the bodies which this substance contains.

Volatile Oil of Lupuline.

This crude essential oil—that is to say, such as has been given by distillation of lupuline with water—is an oleaginous liquid, more or less fluid according to the state of the lupuline which furnished it, and of a specific gravity less than that of water. It has at the same time a somewhat intense colour of yellowish green, more frequently of a beautiful green; its odour recalls slightly that of the hop; but this odour does not resemble that of valerianic acid when the oil has not undergone oxidation or contact with air.

Subjected to distillation, it enters into ebullition at $+140$ degrees ($=284^\circ$ Fahr.), and distils for some time at $+150^\circ$ ($=302^\circ$ Fahr.) to 160 degrees ($=320^\circ$ Fahr.), but the temperature rises gradually, and when the process is finished, is $+300$ degrees ($=572^\circ$ Fahr.)

The portion of this essence obtained between 150° ($=302^\circ$ Fahr.) and 160° ($=320^\circ$ Fahr.) is a sufficiently thin liquid, slightly amber-coloured, of an odour which does not resemble that of the hop, and of a specific gravity of 0·8887. It has not an acid reaction, but, on exposure to air, it acidifies and becomes resinous; it is slightly soluble in water, to which it communicates its odour, and the solution exposed to the air acidifies rather readily; it is soluble in alcohol and in ether. With a cold of -17 degrees ($+1^\circ{\cdot}4$ Fahr.) it lost a little of its fluidity, but its transparency was not altered, even after four or five hours' exposure to that temperature. It deviates to the right the rays of polarized light. Its rotatory power (Dextrogyrate) has been found by the red glass to be $+2{\cdot}7 >$ for the length of $0^{m}{\cdot}080$; it is then of

$$\frac{+{}^{6}2{\cdot}7}{80 \times D}$$

Nitric acid gives at first a beautiful purple colour; afterwards, if heated a little, the reaction becomes more lively, and the products furnished are a resinous matter and valerianic acid.

Potash in solution fails to attack it at a boiling temperature; but if we form an emulsion with a concentrated solution of potash, and expose the mixture for some time to contact with air, we find that there are produced valerianate of potash and a resinous matter.

Fused potassa transforms it into carbonate and valerianate of potassa, with disengagement of hydrogen and of a hydro-carbon liquid.

This reaction of potassa is very important, because, after some useless trials, and a great number of analyses, it rendered clear the true nature of this essence, placing it by the side of the essential oil of valerian.

In fact, the composition obtained by analysis of the crude essence, may be represented by the formula $C_{56}H_{46}O_6$; that of the essence distilled between +150 and 160 degrees (302° and 320° Fahr.) by the formula $C_{22}H_{18}O_2$.

In submitting these essences to the action of fused potassa, there were obtained products in which the quantity of carbon and of hydrogen increased each time that they were submitted to a renewed action of potassa, while the proportion of oxygen decreased. Finally, after many successive treatments, we finished by having a perfectly pure hydro-carbon.

This hydro-carbon is a colourless liquid, which boils at +160 degrees (320° Fahr.) It does not acidify by contact with air; it is as difficult to be altered by contact, for a score of days, with pure oxygen. Its composition, deduced from analysis, is represented by the formula $C_{10}H_8$; it is consequently the same as that of the oil of turpentine and of *bornéène*, which M. Gerhardt has found in the essential oil of Valerian. But this body, although possessing the composition of oil of turpentine and of bornéène, is not the same, but isomerous with these last; for I have not transformed them into solid camphor of Borneo, neither by the action of nitric acid nor by that of potassa. Kept for some time on a solution of potassa, it acquired the odour of thyme, sufficiently to show an approach to thymol.

We see that the action of fused potassa upon the essential oil of hop, consists in setting free a hydro-carbon liquid $C_{10}H_8$, and in retaining an oxygenated body, which it transforms into valerianic acid and carbonic acid; results abso-

lutely similar to what M. Gerhardt has obtained with the essence of valerian.

It is not easy to separate the oxygenised principle of this essential oil, because it is found to be retained in the thickish resinous matter, which does not permit the separation without great difficulty.

The essential oil of lupuline is clearly, then, to be considered as a complex oil, constituted by a hydro-carbon $C_{10}H_8$, and a body containing oxygen of the formula $C_{12}H_{10}O_2$ analogous to *valerol* of the essential oil of valerian. The formula of the crude oil $C_{56}H_{46}O_6$, may be represented by $3\ (C_{12}H_{10}O_2) + 2\ (C_{10}H_8)$; that of the oil rectified between $+150$ and 160 degrees (302° and 320° Fahr.) by $C_{12}H_{10}O_2 + C_{10}H_8 = C_{22}H_{18}O_2$.

The process by which it may be obtained as free as possible from extraneous matter, consists in preparing a tincture of lupuline with alcohol, of 36 degrees; to treat this liquid with an alcoholic solution of tartaric acid, which forms a precipitate somewhat abundant, of bitartrate of ammonia. The liquid separated from the precipitate, is added to a little water, and submitted to gentle heat in a capsule exposed to the air; the alcohol, in evaporating, leaves separate, at the end of two or three days, the resinous matter of the solution, acid and bitter. This bitter liquid is then deprived of the excess of tartaric acid which it contains, and then made to digest with some carbonate of lead recently precipitated; the mass, evaporated at the lowest possible temperature, is treated by boiling alcohol, which dissolves only the bitter matter.

Resinous Matter.

The resinous matter is very abundant in lupuline; it forms itself alone nearly two-thirds of its weight; it retains always a certain quantity of the volatile oily products, which gives to it a variable consistence, and preserves at the same time the peculiar odour of lupuline. It is oxidized by contact with air, especially in presence of water, and its colour then passes from a golden yellow to a deep brown tint, at the same time that it hardens. It is largely soluble in water, to which it communicates the property of lather by agita-

tion. This solution presents an acid reaction, and is completely altered by evaporation in contact with air.

The alkalies dissolve it in the cold, and separate an insoluble part. This resin, insoluble in the alkalies and in water, is soluble in alcohol; it is dry, friable and inodorous. The alkaline solution, saturated by an acid, sets free the resinous matter with its original properties, and retaining some valerianic acid which is got by distillation. Lastly, nitric acid with heat attacks this resin with energy, but without producing special reaction which would serve to characterise it.

To obtain this resin as pure as possible, the lupuline must be exhausted by long boiling in water, which drives off the volatile products, and dissolves the bitter matter. The insoluble residue, composed of resin and of disintegrated tissue of the lupuline grains, well washed and dried, is then treated by boiling alcohol, which sets free, when cooled, a certain quantity of *waxy matter*; the alcoholic liquor, filtered after cooling, furnishes the resin by evaporation of the alcohol.

The wax is contained in the cells which compose the cupule of the lupuline grain; it exists also in the scales which constitute the cone of the hop, and by treating these scales with boiling alcohol, it is procured in sufficient quantity. It is dry and pulverulent, inodorous and tasteless; it begins to soften at +80 degrees (176° Fahr.), and is fully melted at +100 degrees (212° Fahr.) Strongly heated, it gives two volatile products, which diffuse an odour of wax; it burns without residue, producing a white shining flame; this matter resembles, as we see by its properties, the wax of the sugar cane.

[The paper was illustrated by drawings of Lupuline, and a series of specimens from the Industrial Museum, exhibited by Professor Archer.]

Explanation of Plate II.

Fig. 1. Cone of Hop.

Fig. 2. Terminal bud enveloped by the stipules, *s s*, on which are marked the granulations, which represent the cupules and the discs indicated by the figures 14, 15, 16, &c.

Fig. 3. Lupuline originating; *e e*, epidermis; *l*, primordial cellule of lupuline, by which it is attached to the epidermis; *a*, cellule produced

by the preceding, and which gives rise to the following modifications:—

Fig. 4. *e*, epidermis; *l*, primordial cellule; *a*, cellule divided transversely into two; the inferior division constitutes the pedicel of the lupuline, the superior forms the gland of the same.

Fig. 5. *e e*, epidermis; *l*, primordial cellule; *p*, pedicel; *a*, cellule containing grey matter with granules.

Fig. 6. *p*, pedicel: *a*, cellule divided into two longitudinally.

Fig. 7. *p*, pedicel; *a*, represents one of the two cells of the preceding figure, subdivided longitudinally into two; *a'*, is another cellule, not so parted.

Fig. 8. *e*, epidermis; *p*, pedicel; *a*, gland formed of four cellules.

Fig. 9. Gland, represented in figure 7, front view; *a*, is the cell not divided; *a'*, the cell which is parted into two longitudinally.

Fig. 10. Gland *a* of the figure 8, front view.

Fig. 11. The same gland more advanced, in which are seen many cells originating by the intra-utricular mode of multiplication.

Fig. 12. The same gland, seen on the face, and a little farther advanced.

Fig. 13. Gland more advanced, in which the four cellules of figures 10, 11, and 12, are subdivided parallelly to the ray, and parallelly to the circumference; each of the cells is indicated by *a a a a*.

Fig. 14. Gland in which the utricular multiplication is still more advanced. The four mother cells of fig. 10 are still visible, and indicated by *a a a a*.

Fig. 15. Shows the aspect which the glands present when they have acquired a somewhat considerable size; *e*, epidermis; *l*, the gland.

Fig. 16. Glands more advanced. The edges of the discoid glands, as seen in preceding figures, are here raised, forming cupules, *l*, *l*; *e*, epidermis.

Fig. 17. Cupule from the internal (or upper) surface of which the cuticle *d* is detached, and elevated by the secretory products.

Fig. 18. Lupuline, which has acquired its complete development; *c i*, secreting cupule or proper gland, surmounted by the cuticle *c s*, raised up by the products of secretion.

Fig. 19. Grain of lupuline enlarged; *c i*, cupule or gland proper; *i*, point of attachment; *c s*, elevated cuticle. There is seen on this last the impression or trace of the cellules of the cupule, on the cavity of which this cuticle was applied.

Fig. 20. Longitudinal section of a grain of lupuline; *c i*, cupule composed of a single layer, which secretes the contained liquid; *c s*, cuticle detached from the internal surface of the cupule by the secreted liquid.

The figures are from the pencil of M. Trecul.

III. *Remarks on the Sexuality of the Higher Cryptogams, with a Notice of a Hybrid Selaginella.* By Mr John Scott, Royal Botanic Garden, Edinburgh.

Modern researches, on the reproductive phenomena of Cryptogams, have induced a number of botanists to accept the doctrine of their sexuality, this function being attri-

buted to the organs known as the Antheridia and Pistillidia. Amongst those botanists who deny the sexual hypothesis, as applied to Cryptogams, a difference of opinion exists; one class attributing a sexual function to the above organs as occurring in the genera Pilularia, Marsilea, Salvinia, and Isoetes, but strangely arguing, that such an import cannot possibly be attributed to these organs in the other orders; while another class,—with a more consistent scepticism,— refuse to attribute a sexual import to these organs in any order of the class, and regard all as strictly agamic.

It would be mere surplusage, on my part, to give to the Society even the briefest *resumé* of the nature of the evidence on which the sexuality of Cryptogams is based, inasmuch as the writings of Henfrey, Berkeley, Suminski, Hofmeister, &c., have rendered it sufficiently familiar to all, and must satisfy all who have accepted the doctrine that nothing short of hybrids, artificially produced between distinct species of Cryptogams, will induce a universal acceptance of the hypothesis of sexuality as applied to these plants.

Several supposed instances of hybridity have been recorded by authors, but these not being results of direct experimentation, do not by any means place the question beyond the reach of doubt. For example, Hofmeister, in his work " On the Higher Cryptogams," p. 181, states that Bayrhoffer " suggested certain mosses, found by him growing wild, were hybrids between *Gymnostomum pyriforme* and *G. fasciculare* on the one side, and *Funaria hygrometrica* on the other side." Hofmeister, however, remarks that he " has not yet succeeded in producing such hybrids experimentally, although he brought together antheridial plants of *Gymnostomum pyriforme* and plants of *Funaria hygrometrica*, with their antheridial shoots cut off. The mutilated plants of *F. hygrometrica* always perished."

In the case of ferns, it has been asserted that true hybrids exist in the genus Gymnogramma. Braun, in his "Plantarum novarum et minus cognitarum adumbrationes," notices several supposed hybrids belonging to the above genus which have appeared in gardens; and similar notices have from time to time appeared in the " Gardeners' Chronicle." That now well known segregative individualising power of the fern-

spore—if I may term that subordination of the specific formative tendencies in that organ to those casual variations of the segments or pinnæ upon which it originates—ought to make us extremely cautious in ascribing a hybrid origin to any forms that may appear amongst these plants. Furthermore, the hermaphrodite nature of the prothalli, and the juxtaposition of the antheridial and archegonial cells, render the occurrence of hybrids, in the *true* ferns, much less probable, I believe, than in any other order of Cryptogams. The Botrychiums and Ophioglossums, as shown by Hofmeister and Mettenius, afford much higher facilities for successful casual hybridization than occurs in the true ferns. Inasmuch as in the former the antheridial and archegonial cells occur on opposite sides of the prothalli, so that an equal, or even higher facility, is thus afforded for the con junction of distinct individuals than the pure hermaphrodite conjunctions. In the latter—or true ferns—on the other hand, where the antheridial and archegonial cells are produced upon the same side of the prothallus, and this being the under, an examination of the individual relations of the prothalli in a single pot will, I think, suffice to show that the crossing of distinct individuals must here be a most exceptional occurrence; unless, indeed—as so generally occurs in the higher plants—nature has provided certain external agents.

In the Selaginellas, the only genus of the Lycopodiaceæ whose reproductive phenomena are known,* the greatest possible facilities are afforded for hybridization by the unisexual characteristics of their spores, and their production in distinct organs; one kind of spore—microspore—producing

* Hofmeister has the following remarks on the above point:—" The reproduction of those Lycopodiaceæ which bear powdery spores of one kind only, is still a mystery. Repeated sowings of the spores of *Lycopodium clavatum*, *inundatum*, and *Selago*, have yielded me no results; but I have lately often observed, that in spores of *Lycopodium Selago*, which had been sown for from three to five months, numerous small spherical cells had been formed, similar to the mother-celis of the spermatozoa of *Selaginella helvetica*. I have not yet found spermatozoa inside these vesicles. De Bary has lately discovered that the spores of *Lycopodium inundatum* produce a body composed of a few cells, whose structure is not unlike that of the archegonium of a fern. It is probable, from these observations, that the similarly formed spores of Lycopodium, Psilotum, &c., are of different sexes, and, as in *Equisetum arvense*, produce partly *archegonia* and partly *spermatozoa*."—" On the Higher Cryptogams," p. 398.

spermatozoa; the other—macrospore—producing the archegonial cells. From these relations of the reproductive organs, it might be supposed that hybrids would be easily raised experimentally between different species. The only points to be studied being a slight regard to systematic affinities, and the relative time required for the development of the spermatozoa and archegonial cells.* I have found, however, that this is far from being the case; for, after numerous experiments, the subject of the following remarks is the only one to which I can with certainty assign a cross origin. The history of this plant may be thus briefly told:—I placed *thirty macrospores* of *Selaginella Danielsiana* on the surface of a pot of moist sand; over these I strewed thickly the *microspores* of *Selaginella Martensii*, and then closely covered all with a small bell-glass. In case of differences in the time required for the perfect development of the male and female organs of the respective species, for some time after the first sowing, I frequently added fresh microspores of the latter species, *S. Martensii*. Ultimately *one* of the macrospores produced a *germ-plant*, *all the others proving abortive.* The gradual development of this germ-plant I have watched with interest, and I have now the pleasure, through the kindness of Mr M'Nab, of placing it and its parent forms upon the table for the examination of this Society.

Previous to my noticing the individual and relative characteristics of hybrid and parents, there are one or two other points on which I beg to make a few remarks, by way of obviating certain objections which may be advanced against the hybrid nature of my seedling; they are as follows:— A. Braun ("Plantarum novarum et minus cognitarum adumbrationes," 1857, Appendix, p. 16) considers that *Selaginella Martensii* and *S. Danielsiana* are conspecific; and taking the

* A single illustration will show the necessity for attending to the period required for the development of the spermatozoa and archegonia in the species tried. Thus, in the closely allied *Selaginella denticulata* and *S. helvetica*, the spermatozoa and archegonial cells are developed in the former species about six weeks after sowing; whereas, in the latter species, according to Hofmeister, the *microspores* lie *five months*, and the *macrospores* between *six and seven months*, before they produce their respective spermatozoa and archegonia. We thus see that here, as elsewhere, in the vegetable kingdom, other points than recognised systematic affinities must be attended to in hybridizing.

former for the normal or typical form of the species, calls it *S. Martensii normale;* the latter *S. M. compacta.* Three other forms, considered by some as distinct species, have also been referred by Braun to *S. Martensii* under the following names :—*S. M. flaccida, divaricata*, and *congesta.* Mr Moore informs me by letter that he is inclined to agree with Braun in uniting under *S. Martensii* the forms he has so placed; and furthermore, considers that the seedling form which I have raised goes to confirm this view, by showing that varying forms are capable of being produced from the spores; that, in fact, so far as he could judge from the pressed specimen (which I sent him for examination), I had merely produced *S. M. normale* from the *S. M. compacta.* Mr Moore continues, however, that in plants so peculiar as these Lycopods, a good deal of their natural appearance is lost under pressure. In the present instance, the Society will observe, by a comparison of the hybrid and parent plants with the pressed specimens upon the table, the truth of Mr Moore's remarks, as respects the affinities in judging from the dried specimens alone, and, moreover, the need for that express reservation added to the above view, inasmuch as it is at once obvious by a comparison of the living plants, that though nearer *S. Martensii* in the characters of the leaves, it—the hybrid—has much more affinity with *S. Danielsiana* in its general habit.

In consequence, then, of this view of Braun and Moore, respecting the conspecificness of the parent forms, I can only give a provisional significance to the hybridity of my seedling; satisfied, however, that even by an ultimate agreement amongst systematists as to the genetic affinities of the parent forms, it will simply cause a substitution of the term "mongrel," for that of "hybrid," at present given. And thus, that in either case, it will afford a stronger argument in support of the sexuality of the higher cryptogams than any, so far as I am aware, which has yet been recorded.*

* Mr Moore, in answer to a query as to the occurrence of undoubted hybrids amongst the above plants, writes me as follows :—"I am not aware of any well authenticated instances of hybridization among Cryptogams. I have always regarded the varieties of Gymnogrammas (which do sometimes present an appearance intermediate between two known sorts) as sports—chiefly, however, from the want of any direct evidence of hybridity."

On the supposition, however, that Braun has rightly regarded the parent forms of my seedling as conspecific, it may be argued that as the *S. Danielsiana—S. M. compacta—*is the more incipient form of the two experimented upon, it may yet have a *tendency* to produce, by a *truly parthenogenetic process*, a varying offspring from its spores. To this I can answer only as follows, but the answer, I think is satisfactory. *First*, When the *macrospores* of the *S.. Danielsiana* and *S. Martensii* are sown *alone*, *neither*—and I speak from an extensive series of experiments—*will produce a* SINGLE *plant ;* clearly demonstrating, as I think, a sexual reproduction dependent on the mutual action of both kinds of spores. That consequently *parthenogenesis*, in so far as my experience goes, *does not occur in either of these forms ;* nor indeed *in any of the species of Selaginella which I have tried, if sufficient care be taken to exclude the microspores.* Again, *secondly*, When the *microspores* and *macrospores* of the *S. Danielsiana* and *Martensii* are each purely commixed and respectively sown in distinct pots, they reproduce themselves perfectly, as I have in several instances proved by experiments. That the Society may be enabled to judge as to the truth of this statement, I have placed upon the table seedling plants of both forms, all of which betray at once their respective parents. Conjoining, then, the latter with the foregoing evidence, *i.e.*, the non-development of the macrospores when sown alone, and the facility with which both forms reproduce themselves when *the two kinds of spores* are mixed ; and comparing them with the previously given history of the presumed hybrid, we are thus, as I am inclined to think, afforded, *firstly*, most conclusive evidence of the existence of true sexual organs in these plants ; and, *secondly*, indubitable proofs of the mixed origin of the seedling plant.

Let us now see in how far this view of the mixed origin of the seedling plant is supported by an individual and comparative examination of the morphological characteristics of the latter and its parent forms. First, for the individual characteristics :—

1. *Selaginella Martensii.—Spike* sessile, linear, somewhat attenuated, from 8 to 10 millimetres long. *Bracteas* ovate, acuminate, denticulate. *Microsporangia* ovate, subtruncate, tumid, $\frac{3}{4}$ of a millimetre. *Microspores* reddish-orange,

$\frac{1}{30}$ of a millimetre, somewhat wrinkled and granulated. *Macrospores*, greyish-white, $\frac{1}{3}$ of a millimetre, reticulated. *Stem* ascending, flexuose at the extremity, branches spreading. *Leaves* oblong-ovate, oblique, falcate, somewhat blunt, 3 to 4 millimetres long; anterior base sub-dilated, margin ciliated, posterior base rounded, margin denticulated. *Stipuliform leaves* oblong or oblong-ovate, acuminate, denticulate, carinate, recurved, 2 millimetres long; exterior base auricled, and bordered with a few long hairs; interior rounded, and nearly entire.

2. *Selaginella Danielsiana.*—*Spike* sessile, short and thick, 6 to 7 millimetres long. *Bracteas* ovate, acute, denticulate. *Microsporangia* oblong, tumid, $\frac{3}{4}$ of a millimetre. *Microspores* brownish-grey, wrinkled and granulated as in *S. Martensii*, $\frac{1}{28}$ of a millimetre. *Macrospores* white $\frac{2}{5}$ of a millimetre, reticulated. *Stem* ascending, branches short, rigid, erect, sub-fastigiate. *Leaves* ovately-oblong, 4 to 5 millimetres long; anterior base dilated, and sparingly fringed with long hairs; posterior base sub-truncate, margin entire. *Stipuliform leaves* ovate, acuminated, carinate, recurved, 3 millimetres long; exterior base auriculate, margin sparingly ciliated; interior base rounded, margin entire.

3. *Selaginella Danielsiana-Martensii.*—*Spike* sessile, short and thick, 3 to 4 millimetres long. *Bracteas* ovate-triangular, shortly mucronate, denticulate. *Microsporangia* ovate-oblong, half a millimetre long, tumid. *Microspores* brownish-grey, finely granulated, *size very variable*, from the 38th to 30th of a millimetre; *a high percentage apparently imperfectly developed.* *Macrospores* white, $\frac{1}{4}$ of a millimetre, obscurely reticulated. *Stem* ascending, branches numerous, short, rigid, erect, and sub-fastigiate. *Leaves* oblong-ovate, bluntish, slightly oblique, 2 to 3 millimetres long; posterior margin denticulated; anterior margin entire. *Stipuliform leaves* lanceolate-ovate, shortly mucronate, carinate, 1 to 2 millimetres long.

Again, *secondly*, by a relative comparison of the hybrid and parent forms, we have something like the following results:—*First*, in the short, erect, rigid, and somewhat fastigiate branches (destitute of any principal or leading shoots) of the hybrid plant we have a marked characteristic of the female parent, the *S. Danielsiana.* As in the latter

species, the right and left forks of the terminal bud are in general imbued with an equal degree of the vegetative force, so that both forks being developed alike, the plants thereby assume a dwarf, compact, bushy habit. In the male parent—*S. Martensii*—on the other hand, the right and left forks of the terminal bud are alternately more vigorously developed, so as to give rise to an apparently principal axis, or leading shoot, with a right and left series of branches, and a lax, somewhat spreading habit to the plants. *Secondly*, In the form of the leaves, and their somewhat lax rachidal disposition, the hybrid exhibits more affinity with the male than the female parent, the only difference being a decreased size. In the denser cellular structure of these organs, however, and likewise in the deep lustrous green, with the brownish-tinted stems, the hybrid again approaches the female parent. In the form of the stipuliform leaves and bracteas, it differs from either parent, and here approaches another of the forms which Braun has referred to the *S. Martensii*, viz., *S. M. congesta*. *Thirdly*, In respect to the characteristics of the organs of fructification, there is a great similarity in the three forms, those of the hybrid being the smallest. There is one point, however, in connection with them, worthy of a passing notice, namely, the relatively great variability in the sizes of the microspores of the hybrid—a high percentage of which are badly developed—as compared with those of the parents; while the macrospores, though smaller than those of the latter, present in general very trifling relative differences, and so far as I can judge, until I have time to test their germinative capabilities, perfectly developed. We have here a curious and interesting—real or apparent—analogy, with that which occurs in the phenomena of sterilisation in the hybridisation of the higher plants. Hybridists have shown, that in the latter class of plants, the pollen is more susceptible to the sterilising action than the ovules, and that in general, perhaps invariably, as has been maintained, we find that if the anther-cases contain a few grains of perfectly developed pollen, the ovaries also will contain a higher percentage of ovules capable of fertilisation.*

* I believe an exception, of which I will satisfy myself at the approaching

IV. *Abstract of a paper on the Constitution of Gymnospermous Flowers.* By A. W. Eichler. Communicated by Professor Balfour.

V. *List of Fossil Plants found in the Tertiary Strata of the South-East of France.* By Gaston de Saporta. Communicated by Professor Balfour.

(From "Annales des Sciences Naturelles," 4th ser. Bot. tom. xix.)

Algæ. Chara destructa, *Sap.*
Musci. Muscites intricatus, *Sap.* (allied to Bartramia fontana, *DC.*)
Filices. Goniopterites lacerus, *Sap.*
Equisetaceæ. Equisetum lacustre, *Sap.* (allied to Equisetum arundinaceum, *Bory.*)
Coniferæ. Callitris Brongniartii, *Endl.* (allied to Callitris quadrivalvis, *Vent.*); C. Heerii, *Sap.* (allied to Callitris quadrivalvis, *Vent.*); Libocedrites salicornioides, *Endl.* (allied to Libocedrus decurrens, Thuiopsis dolabrata, *Sieb.* et *Zucc.*); Widdringtonia antiqua, *S.* (allied to Widdringtonia cupressoides, *Endl.*); Frenelites ? exul, *Sap.*; Juniperites ambiguus, *Sap.* (allied to Juniperus phœnicea, *L.*; Juniperus excelsa); Peuce aptensis, *Sap.*; Pinus zachariensis, *Sap.* (allied to Pinus Strobus, *L.*)
Taxaceæ. Podocarpus eocenica, *Ung.* (allied to Podocarpus elongata, *Herit.*)
Gramineæ. Arundinites confusus, *Sap.*
Cyperaceæ. Carex ? tertiaria ? *Heer.* (allied to Carex stricta, *Good.*); Cyperites gramineus, *Sap.*; C. Zollikoferi ? *Heer.*
Rhizocauleæ. Rhizocaulon Brongniartii, *Sap.*; R. gracile, *Sap.* (allied to Thamnochortus scariosus, *R. Br.*); R. polystachyum, *Sap.* (allied to Restio complanatus, *R. Br.*, quoad inflorescentiam).
Palmæ. Flabellaria gargasensis, *S.*; F. incerta, *Sap.*; F. thrinacea, *Sap.* (allied to Thrinax argentea, *Hort.*); F. pumila, *Sap.*; Palmacites vestitus, *Sap.*; P. vaginatus, *Sap.*: P. erosus, *Sap.*; P. grandis, *Sap.*
Smilaceæ. Smilax linearis, *Sap.* (allied to Smila xmollis, *H. B. K.*, and S. triplicinervia, *H. B. K.*); S. sagittiformis, *Sap.* (allied to Smilax aspera, S.); S. elongata, *Sap.*
Dioscoreaceæ. Dioscorites resurgens, *Sap.* (allied to Rajania, *sp.*; Dioscorea Zollingeriana, *Kunth*, and D. nummularia, *Lam.*)
Naiadaceæ. Potamogeton lucidus, *Sap.*; P. enantophyllus, *Sap.* (allied to Potamogeton pectinatus, *L.*)
Typhaceæ. Typha latissima, *A. Braun* (allied to Typha latifolia. *L.*); Sparganium stygium, *Heer.* (allied to Sparganium natans, *L.*); S. valdense, *Heer.* (allied to Sparganium ramosum, *L.*)
Myricaceæ. Myrica pusilla, *Sap.*; M. minima, *Sap.*; M. rotundiloba, *Sap.*; (allied to Myrica esculenta, *Don.*); M. elongata, *Sap.* (allied to Myrica serrata, *Lam.*); M. tenuinervis. *Sap.*; M. zachariensis, *Sap.* (allied to Myrica californica, *Hort.*, and M. pennsylvanica, *Lam.*)
Betulaceæ. Betula ulmacea, *Sap.* (allied to Betula lutea, *Michx.*); Alnus prisca, *Sap.* (allied to Alnus incana, *DC.*, and A. glauca, *Michx.*)

flowering period, to the above law, occurs in the bigeneric hybrid of the *Rhododendron Chamæcistus*, and the *Menziesia empetrifolia*—the *Bryanthus erectus* (Graham), inasmuch as I have found apparently well-developed pollen grains in the anther-cases, yet I have repeatedly failed in fertilising this plant with its own pollen, or that of either parent.

Cupuliferæ. Ostrya tenerrima, *Sap.* (allied to Ostrya vulgaris, *Lam.*, var.); Carpinus cuspidata, *Sap.* (allied to Carpinus orientalis, *Lam.*); Quercus elæna, *Ung.* (allied to Quercus confertifolia, *H. B.*; Q. cinerea, *Michx.*; Q. mexicana, *Humb.*); Quercus cuneifolia, *Sap.* (allied to Quercus Banisteri, *Loud.*; Q. ilicifolia, *Wang.*, and Myrica quercifolia, *S.*)

Ulmaceæ. Ulmus primæva, *Sap.* (allied to Ulmus montana, *Smith.*)

Moraceæ. Ficus reticulata, *Sap.* (allied to Ficus saxatilis, *Bl.*); F. paradoxa, *Sap.* (allied to Ficus salicifolia, *Vahl.*)

Salicaceæ. Populus palæocarpa, *Sap.*; Salix protophylla, *Sap.* (allied to Salix cinerea, *L.*)

Daphnaceæ. Daphne? abscondita, *Sap.* (allied to Daphne Laureola, *L.*)

Lauraceæ. Laurus præcellens, *Sap.* (allied to Lauri et Perseæ, *sp.*); L. primigenia, *Ung.* (allied to Laurus canariensis, *Web.*); L. elongata, *Sap.* (allied to Benzoin citriodorum, *Sieb.* et *Zucc.*); Cinnamomum lanceolatum, *Heer.*; C. spectandum, *Sap.*; Daphnogene tenebrosa, *S.* (allied to Oreodaphne fœtens, *Nes.*)

Santalaceæ. Leptomeria distans, *Ett.* (allied to Leptomeria Billardieri, *R. Br.*)

Proteaceæ. Palæodendron coriaceum, *Sap.* (allied to Protea caulescens, *Ehr.*); P. salicinum, *Sap.*; P. lanceolatum, *Sap.*; P. mucronatum, *Sap.*; P. socium, *Sap.*; Grevillea acuta, *Sap.* (allied to Grevillea oleoides, *Sieb.*; G. riparia, *R. Br.*; G. acuminata, *R. Br.*); Hakea mahoniæformis, *Sap.* (allied to Hakea amplexicaulis, *R. Br.*); H. ilicina, *Sap.* (allied to H. attenuata, *R. Br.*); H. redux, *Sap.* (allied to H. cinerea, *R. Br.*; H. loranthifolia, *Meissn.*; H. obtusa, *Meissn.*); H. demersa, *Sap.*; H. palæoptera, *Sap.*; Lomatites gracilis, *Sap.* (allied to Lomatia longifolia, *R. Br.*); Myricophyllum zachariense, *Sap.* (allied to Myrica æthiopica, *L.*? Banksia præmorsa, *Andr.*; B. littoralis, *R. Br.*); M. obtusatum, *Sap.*; M. rigidum, *S.*; M. anceps, *S.*; M. bituminosum, *Sap.*; Banksites integer, *Sap.* (allied to Banksia integrifolia, *R. Br.*); B. costatus, *Sap.* (allied to Banksia coccinea, *R. Br.*); B. insignis, *Sap.* (allied to Banksia latifolia, *R. Br.*); B. obscurus, *Sap.*; Dryandroides primigenia, *Sap.*; B. cuneata, *Sap.*

Apocynaceæ. Echitonium cuspidatum, *Heer*; E. Sophiæ, *O. Weber* (allied to Nerium, *sp.*)

Myrsinaceæ. Myrsine clethrifolia, *Sap.* (allied to Myrsine semiserrata, *Wall.*)

Ebenaceæ. Diospyros hæringiana, *Ett.* (allied to Diospyros lanceolata, *Roxb.*; and D. Ebenum, *Wall.*)

Sapotaceæ. Sapotacites latifolius, *Sap.* (allied to Achras sapota, *L.*)

Ericaceæ. Andromeda coriacea, *Sap.* (allied to Leucothoe multiflora, *DC.*); A. subprotogæa, *Sap.* (allied to Leucothoe salicifolia, *Benth.*); A. protogæa, *Ung.* (allied to Andromeda eucalyptoides, *DC.*; A. vacciniifolia, *Ung.* (allied to Leucothoe, *sp.*)

Araliaceæ. Aralia (Oreopanax?) cœlestis, *Sap.* (allied to Oreopanax capitatus, *Dcne*, and Dendropanax alaris, *Dcne* et *Pl.*); A. (Sciadophyllum?) Gaudini, *Sap.* (allied to Sciadophyllum villosum, *Pl.* et *Lind.*, and S. Browni, *Sp.*; A. rigida, *Bl.*; A. lutescens, *Bl.*; A. aromatica, *Bl.*); A. (Sciadophyllum?) zachariensis, *Sap.* (allied to Sciadophyllum, *sp.*); A. (Paratropia?) Decaisnei, *Sap.* (allied to Paratropia obliqua, *Bl.*); A. (Arthrophyllum?) inæquifolia, *Sap.* (allied to Arthrophyllum javanicum, *Bl.*); A. (Panax?) Knightioides, *Sap.* (allied to Panax arboreus, *Forst.*); A. (Panax?) reticulata, *Sap.*

Saxifragaceæ. Ceratopetalum? delicatissimum, *Sap.* (allied to Ceratopetalum gummiferum.)

Nymphæaceæ. Nymphæa polyrhiza, *Sap.*
Sterculiaceæ. Sterculia minuta, *Sap.* (allied to Sterculia heterophylla, *H. P.*)
Byttneriaceæ. Pterospermites palæophyllus, *Sap.* (allied to Pterospermum acerifolium, *L.*)
Aceraceæ. Acer primævum, *Sap.*
Malpighiaceæ. Malpighiastrum janusiæforme, *Sap.* (allied to Janusia gracilis, *Adr. J.*)
Sapindaceæ. Dodonæa confusa, *Sap.* (allied to Dodonæa angustifolia, *L.*); D. cycloptera, *Sap.*; Sapindus fragmentaria, *S.*
Celastraceæ. Celastrus proximus, *Sap.* (allied to Celastrus laurinus, *Thbg* ?); C. sordidus, *Sap.*; C. opacus, *Sap.* (allied to Celastrus zellino, *Schimper*); C. zachariensis, *Sap.* (allied to Celastrus Schimperi, *Hochst.*); C. ignotus, *Sap.* (allied to C. lucidus, *Wall.*)
Ilicaceæ. Ilex dryandræfolia, *Sap.* (allied to Ilex madagascariensis, *Lmk.*; I. magellanica, and I. odora, *Sieb.* et *Zucc.*); I. lacera, *Sap.*
Rhamnaceæ. Paliurus litigiosus, *Sap.* (allied to Paliurus aculeatus, *L.*); Zizyphus Ungeri, *Heer.* (allied to Zizyphus sphærocarpus, *Tul.*); Z. senescens, *Sap.* (allied to Zizyphus timorensis, *Dcne.*; Z. sinensis, *L.*, and Z. iguanea, *Lam.*)
Euphorbiaceæ. Euphorbiophyllum minus, *Sap.*
Juglandaceæ. Engelhardtia decora, *Sap.* (allied to Engelhardtia serrata, *Bl.*); E ? inquirenda, *Sap.*
Anacardiaceæ. Schinus deperditus, *Sap.*; Rhus minuta, *Sap.* (allied to R. oxyacanthoides, *L.*); R. gracilis, *Sap.* (allied to R. aromatica, *Lam.*); R. prisca, *Ett.*; R. copalifolia, *Sap.* (allied to R. copallina, *L.*)
Zanthoxylaceæ. Zanthoxylon inconspicuum, *Sap.*
Myrtaceæ. Myrtus caryophylloides, *S.* (allied to Caryophyllus aromaticus, *L.*); M. aptensis, *Sap.* (allied to Eugenia australis, *Hort.*); M. rectinervis, *Sap.* (allied to Myrica acris, *DC.*, and Calyptranthes zyzygium, *Swartz*).
Pomaceæ. Cratægus palæacantha, *Sap.* (allied to Cratægus tanacetifolia, *L.*, and C. spathulata, *Michx.*)
Leguminosæ. Psoralea palæogæa, *Sap.* (allied to Psoralea bituminosa, *L.*); Robinia elliptica, *Sap.* (allied to Robinia viscosa, *Desf.*); Phaseolites pulchellus, *Sap.* (allied to Cyanospermum, *sp.*); P. glycinoides, *Sap.*; Dalbergia valdensis, *Heer.* (allied to Dalbergia cultrata, *Grah.*; D. confertifolia, *Benth.*, and D. rubiginosa, *Roxb.*); Andira ? tenuinervia *Sap.*; Sophora europæa, *Ung.* (allied to Sophora tomentosa, *L.*), Edwardsia ? reticulata, *S.* (allied to Edwardsia grandiflora, *Salisb.*); Cassia phaseolites, *Ung.* (allied to Cassia micranthera, *DC.*); Cassia Berenices, *Ung.* (allied to Cassia lævigata, *W.*); Cæsalpinites litigiosus, *Sap.* (allied to Colutea orientalis, *L.* ?, Cæsalpinia bijuga, *L.*, and C. bahamensis, *Lam.*); C. ellipsoideus, *Sap.*; C. copaiferinus, *Sap.* (allied to Copaifera glabra, *Vog.*); C. minutus, *Sap.*; Leguminosites latiusculus, *Sap.*; L. ignotus, *Sap.*; L. deletus, *Sap.*

VI. *Notice of Plants at present in Flower in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Of the 35 species and varieties of spring-flowering plants recorded as being in bloom during the month of December 1863, only 15 are now to be found in flower, viz., *Eranthis hyemalis*, *Helleborus abschasicus*, *H. olympicus*, *H. purpurascens*, *Hepatica triloba*, *Arabis albida*, *Petasites nivea*, *Erica herbacea*, *Gentiana acaulis*, *Primula elatior* var., *P. vulgaris*, *Corylus Avellana*, *Sisyrinchium grandiflorum*, *Galanthus ni-*

valis, and *Crocus susianus*. From the 1st of January up to this date, 4 species only have been added to the list, viz., *Nordmannia cordifolia*, *Galanthus plicatus*, *Leucojum vernum*, and *Crocus vernus*, making in all 19 species in flower at this time. Out of the 19 only 9 species are in full bloom, viz., *Eranthis hyemalis*, *Helleborus abschasicus*, *H. olympicus*, *H. purpurascens*, *Corylus Avellana*, *Sisyrinchium grandiflorum*, *Galanthus nivalis*, *G. plicatus*, and *Crocus Susianus*. The first flowers of the Snowdrop were open at the end of December 1863. It has been much retarded by the late inclement weather, and it is only now that we see it in full flower. This remark is also applicable to *Crocus susianus*, which opened its first blooms towards the end of December. The *Crocus vernus* and its varieties are only now showing flower-buds, except in warm sheltered borders, where the first flowers opened on the 16th of February.

Last year we had the first flowers of the *Ribes sanguineum* open on the 2d day of March; at this time it has scarcely commenced bursting its buds. The *Narcissus pumilus* was in flower on the 8th of March; it is only now pushing through the ground. The *Erythronium Dens-canis* was in bloom on the 4th of March; it is only now breaking the surface soil. The same remark applies to the *Puskenia scilloides*, which was in flower last year on the 9th day of March. The crown imperial (*Fritillaria imperialis*) was in flower last year on the 22d of March, the flower stems being then 3 feet high; it is only 4 inches through the ground at this date.

Specimens of *Pterolobium elegans*, Vogel, were exhibited from Dr Richard de Gambleton Daunt, Campinas, San Paulo, Brazil. The plant is used as an article of materia medica. It has leaves with six to nine oblong or ovate-oblong pinnæ, smooth on both sides, subcoriaceous; legume smooth, subulate, rounded at the apex. It resembles *P. dasycarpum*. Branches are terete, covered with a spongy, suberous bark; branchlets sub-compressed, warty or smooth, pubescent or glabrous. Common petiole subterete, slightly hairy, 5 to 6 inches long; pinnæ shortly petiolulated, three to four pairs, usually with an odd leaflet, rounded at apex, retusely-emarginate, rounded at the base, smooth on both sides, reticulate-veined, light-green above, lighter coloured below, 2 to 3 inches long, ½ to 1 inch broad. Racemes hirsutely-pubescent or smooth. Flowers differ from those of *P. dasycarpum*, in having longer pedicels, smaller and much less pubescent calyx, and in the ovary being much less hairy; petals with a papilionaceous præfloration; the legume also differs in being not so broad, smooth, and furnished with a narrow wing above. The embryo frequently occurs with a radicle not incurved; cotyledons for the most part green.

Sellow gathered the plant in San Paulo, near Ypanéma, in Minas Geraes, near Capibury, and other places.

A description of the plant in Portuguese, was transmitted by Mr Joaquin Correa de Mello.

The plant is used medicinally in Brazil. A decoction of the bark of the root is prescribed in syphilitic cases. A vinous solution is also used in cases of epilepsy. It is also employed as an anthelmintic.

Specimens were also shown from Dr Bowen of a plant called *Huanarpó*, in Peru, and which appears to be *Jatropha podagrica*, gouty-stalked *Jatropha*, belonging to the natural order *Euphorbiaceæ*. It is used by the natives as a stimulant and strengthening remedy. It has a remarkable discoid pith.

24*th March* 1864.—Professor BALFOUR, President, in the Chair.

The Society met at the Royal Institution, in the rooms of the Royal Society, the use of which had been kindly granted by the Council of the Royal Society.

H. R. H. PRINCE ALFRED took his seat an an honorary Fellow of the Society, and inscribed his name in the list of Fellows.

Professor BALFOUR then exhibited a set of dried specimens of plants illustrating the flora of Lochnagar. The dried plants were arranged on large sheets of pasteboard, in such a way as to show the relative heights at which the plants occur from Balmoral to the summit of the mountain, 3800 feet above the level of the sea. The plants were almost entirely collected on Lochnagar.

Mr FINDLAY ANDERSON exhibited a series of original drawings of Ceylon plants by the late Mrs Colonel Walker, who had contributed much to the flora of that island.

Professor DOUGLAS MACLAGAN having taken the Chair,

Professor BALFOUR proceeded to deliver an address on Fossil Plants. The Professor remarked—At different periods of the world's history, new mineral beds have covered the surface of the earth, and elevations of portions of its crust have taken place, while at the same time the living beings inhabiting it have been buried in sedimentary deposits, to be replaced by a creation more or less distinct from the preceding one. Some of these epochs have been marked apparently by great changes in the climate and physical state of our planet, and they have been accompanied with equally great modifications in the nature of the living beings which inhabited it. The remains of animals and plants in the stratified rocks of the globe have furnished to the geologist data by which he can, as it were, read the history of its formation. The remains of plants are not found in such a condition as to supply data equally important as do those

of animals; still sufficient evidence is afforded by them of the characters of the flora of different epochs, and the palæontologist is enabled to draw valuable deductions from them. There seems to be no reason to doubt that the plants of previous epochs, however far distant from our own, may all be referred to the great classes distinguished at the present day—Thallogens, Acrogens, Gymnosperms, Endogens, and Exogens—that is, to the cellular plants, such as sea-weeds; the vascular cryptogams, as ferns and their allies; the naked-seeded plants, as the firs, pines, and cycads; and the two divisions of angiospermous flowering plants, the monocotyledons and dicotyledons. Although at each marked epoch, we find a greater or less intermixture of plants belonging to all these classes, still there is an evident predominance of certain of them at different periods, which seems to show progress in development, particularly in passing from the flowerless to the flowering plants; and in looking at this progress, we appear to find in the stony tablets of the earth indications of that natural system which has been only fully enunciated, as regards modern plants, since the commencement of the present century. The farther we recede in geological history from the present day, the greater is the difference between the fossil plants and those which now occupy the surface. At the time when the coal-beds were formed, the plants covering the earth belonged to genera and species not recognised at the present day. As we ascend higher, the similarity between the ancient and the modern flora increases; and in the latest stratified rocks we have, in certain instances, an apparent identity at least as regards genera. I say *apparent*, for we shall see that there are great difficulties attending such a determination. At early epochs the flora appears to have been uniform—to have presented less diversity of forms than at present, and to have been similar in the different quarters of the globe. The vegetation also seems to indicate that the nature of the climate was different from that which characterises the countries in which these early fossil plants are now found. Taking the great classes of the vegetable kingdom, the following table shows approximately the relative number of fossil and modern plants belonging to them:—

	Recent.	Fossil.
Thallogens, ...	9,000	203
Acrogens, ...	4,000	969
Gymnosperms, ...	230	363
Endogens, ...	14,000	142
Exogens, ...	67,000	547
Total,	94,230	2224

Fossil plants are by no means so easily examined as recent species. They are seldom found in a complete state. Fragments of stems, leaves, and fruit, are the data by which the plant is to be determined. It is very rare to find any traces of reproductive organs. The parts of the fossil plants are usually separated from each other, and it is very difficult to ascertain what are the portions which should be associated together so as to complete a specimen. The anatomical structure of some of the organs, especially of the stem and root, can sometimes be detected by thin slices being placed under the microscope. The authors of fossil floras have often to found their genera and species, and to form their restorations, on very imperfect specimens. Their work must be to a great extent of a provisional nature, and their opinions very liable to change with the discovery of additional fossil specimens.

Professor Balfour then pointed out the difficulties in the way of the determination of fossil plants on account of the mode in which they had been preserved. Rash geological statements and conclusions often arise from imperfect knowledge of the sciences of zoology and botany. Fronds of ferns of different external forms have been described as distinct fossil species, or even genera, the geologist not knowing that very different forms of fronds are exhibited by the same species of fern in the present day. Again, another error has arisen from the same form of frond being considered as indicating the same species, whereas the same form does occur in different genera in the present flora; and these can only be distinguished by the fructification, which in fossil ferns is rarely seen. The cortical markings of plants have been made to characterise different genera and species, while the fact that dissimilar markings occur on the same bark, according as it is viewed on its inner or outer

surfaces, has often been neglected. These and numerous instances might be adduced to show the necessity for a perfect acquaintance with the present flora in all its details before the geologist can determine fossils, or the character of the climate of palæontological epochs.

Dr Balfour then considered the information furnished by the anatomical structure of plants, and showed its bearing on the determination of orders. He illustrated this by the scalariform and punctated vessels of plants as characterising ferns and conifers. In order to study fossil plants well, there must be an acquaintance with systematic botany, a knowledge of the microscopical structure of all the organs of plants, such as their roots, stems, barks, leaves, fronds, and fruit; of the markings which they exhibit on their different surfaces; and of the scars which some of their leaves make when they fall. It is only thus that we can expect to determine accurately the living affinities of the fossil. Again, before drawing conclusions as to the climate or physical conditions of the globe at different geological epochs, the botanist must be well informed as to the vegetation of different countries, as to the soil and localities in which certain plants grow, whether on land, or in the sea, or in lakes, on dry or marshy ground, in valleys or on mountains, or on estuaries in hot, temperate, or cold regions. In considering the physiognomy of vegetation at the present day, we find remarkable forms associated. Thus palms, though generally characteristic of very warm countries, are by no means confined to them—*Chamærops humilis* extending to Europe and *C. Palmetto* growing further north in America. The late Colonel Madden read to the Botanical Society a very instructive paper on the occurrence of tropical forms—as bamboos and palms—in the Himalayas, associated with coniferous and other trees of temperate and cold climates. Even orchids, which are characteristic plants of hot countries, have representatives high up on the Andes. The stratified rocks of the globe were then enumerated as characterised by fossil plants such as Acrogens, Gymnosperms, and Angiospermous Monocotyledons and Dicotyledons. Ferns were particularly considered as regards their determination, and the indication which they furnish as to the general flora and the climate. The prevalence of ferns

indicates a paucity of other plants, and a temperate, somewhat moist, climate.

The plants of the Silurian, Old Red Sandstone, Coal-Measures, Permian, Trias, Lias, Oolite, Wealden, Chalk, and Tertiary epochs were then considered, and illustrated, by means of specimens and large drawings, many of which had been executed by Dr Greville. The more important fossil plants were shown in a restored condition, and contrasted with those of the present day. A large oil painting, executed by Mr Neil Stewart, was shown, exhibiting at one view the characteristic flora of the coal epoch. In reference to the coal epoch, Dr Balfour quoted the following remarks of the late Hugh Miller:—"The sculpturesque character of the richly fretted Sigillarias was shared by not a few of its contemporaries. The Ulodendrons, with their rectilinear rows of circular scars, and their stems, covered with leaf-like carvings, rivalled in effect the ornately-relieved torus of a Corinthian column. Favularia, Knorria, Halonia, many of the Calamites, and all the Lepidodendrons, exhibited the most delicate sculpturing. In walking among the ruins of this ancient flora, the palæontologist almost feels as if he had got among the broken fragments of Italian palaces erected long ages ago, when the architecture of Rome was most ornate, and every moulding was roughened with ornament; and in attempting to call up in fancy the old carboniferous forests, he has to dwell on this peculiar feature as one of the most prominent; and to see, in the multitude of trunks, darkened above by clouds of foliage, that rise before him in the prospect, the slim columns of an olden Alhambra, roughened with arabesque tracery and exquisite filagree work." Tables were given, which showed the relative proportions of the different classes of plants of the various fossil periods as contrasted with the modern flora. The structure of coal was also examined in all its forms, from the cannel coal to the household coal, as well as the coal of the Oolite and Tertiary strata. The following were the concluding remarks:—

"All these floras to which I have referred, have, I believe, preceded the appearance of man upon the earth. The sombre hues of the uniform, and, so to speak, monotonous flora of the Palæozoic epochs, with their flowerless ferns

and Lycopods, passed into the more varied vegetation of the Cainozoic periods, till at length in the Tertiary, we find plants with still more diversified forms, which, by the production of flowers and fruit, more nearly resemble those of the present day. The modern flora has assumed a different type; and while we have in it all the classes of vegetation represented which have already appeared on the globe, we find that man's appearance has been more especially associated with plants pleasant to the eye, grateful to the senses, and good for food. Special provision appears to have been made for the being formed after the image of God, who could look on the wonders of creation with the eye of intelligence, who was gifted with powers of mind fitting him for the study of God's works, and qualifying him to observe the order and beauty of the universe around him, and to whom were given for enjoyment every herb bearing seed, which was on the face of all the earth, and every tree in which is the fruit of a tree yielding seed. But 'who shall declare,' as Hugh Miller remarks, 'what through long ages the history of creation has been? We see at wide intervals mere fragments of successive floras, but know not how what seem the blank interspaces were filled; or how, as extinction overtook in succession one tribe of existences after another, and species, like individuals, yielded to the great law of death, yet other species were brought to the birth and ushered upon the scene, and the chain of being was maintained unbroken. We see only detached bits of that green web which has covered our earth ever since the dry land first appeared; but the web itself seems to have been continuous throughout all time; though ever, as breadth after breadth issued from the creative loom, the pattern was altered, and the sculpturesque and graceful forms that illustrated its first beginnings and its middle space have yielded to flowers of richer colour and blow, and fruits of fairer shade and outline: and for gigantic club-mosses stretching forth their hirsute arms, goodly trees of the Lord have expanded their great boughs; and for the barren fern and the calamite clustering in thickets beside the waters, or spreading on flowerless hill-slopes, luxuriant orchards have yielded their ruddy flush, and rich harvests their golden gleam.'

Although there have been thus changes and variations

in the flora of the globe, and a certain degree of progress in connection with the adaptation for the wants of the living creatures which have successively appeared, there is no evidence whatever of transmutations of species; there are no transition forms which can be shown on the hypothesis of Darwin to have sprung out of former species. There are as distinct lines of demarcation between the species of the old times as there are between those of the present day. The theoriser has asked for time, in order that the new species may be formed out of the old by natural selection and struggle for existence; but here abundance of time is given, and yet, tried by the test of time, the theory is found wanting, and its failure, though acknowledged by the author, is attributed only to the imperfection of the geological record.

While man is gifted with the power of roaming over the whole earth, of studying the vegetation of different regions, and of forming systems of classification and of geographical distribution, he has been enabled also to fathom, as it were, the depths of creation, and to bring up from the lower strata of this world the monuments of bygone forms of life. He has, moreover, been gifted with that moral perception which can trace in all the hand of a wonder-working Creator, and can read, in the creation around him, the harmony between the Word and the works of Him by whom all things subsist, who spake and it was done, who commanded and it stood fast. The facts of geology must ever be in accordance with the Divine Revelation, and we can have no fear of true science. In looking back to these ancient floras, and contrasting them with the vegetation of the present day, we see a unity of purpose and design which tells us of an Almighty and an allwise Creator and Preserver; and in looking forward to the future of this world, when, as revealed to us, 'the elements shall melt with fervent heat, and the earth and the works that are therein shall be burnt up,' we take our firm stand on His promise, that there shall be new heavens and a new earth, wherein righteousness shall dwell.

Brief notices were given by Professor Archer upon the following vegetable productions, which were shown in the International Exhibition of 1862, and now in the Industrial Museum of Scotland.

Food Specimens.

From Ceylon, the fruits of *Canarium commune*, used as an edible nut, and known by the European residents as the "wild almond."

The fruits of *Flacourtia sapida* and *F. inermis*, the small berry-like fruits of the Artocarpaceous shrub *Aporoa Lindleyana*, and the berries of *Syzygium caryophyllatum*, a myrtaceous plant.

From Greece, Turkey, and Spain, dried Azaroles, the fruits of *Cratægus Azarola.*

The root tubercles of *Cyperus esculentus*, used as chestnuts in Turkey and Greece, when boiled.

The receptacles of the common artichoke (*Cynara Scolymus*), dried and used, when soaked and boiled, as a dinner vegetable in Italy, where it is called *Carciofa domestica.*

The seeds of *Nigella damascena*, grown and used as a condiment in Turkey. And from the same country the much admired almond-flavoured kernels of *Prunus Mahaleb*, used in confectionary.

The edible seed of *Chenopodium Quinoa*, called by the Peruvians *Quinoa blanca*, which forms so large a part of the food of the inhabitants of Peru, Chili, and Bolivia; and the manna or sugar of *Eucalyptus mannifera*, eaten as a sweetmeat in Australia.

The Achenia of *Gundelia Tournefortia* from Turkey, and the seeds of *Cassia occidentalis* from Uruguay and Trinidad, were shown as substitutes for coffee; and the leaves and stems of the herbaceous plant, *Stachys Heraclea*, L., as a tea substitute, used by the modern Greeks, and believed to be the "Sideritis" of the ancients.

And a series of alcohols from the fruit of *Arbutus Unedo*, the roots of *Helianthus tuberosus*, and the bulbs of *Asphodelus ramosus* and *Pancratium maritimum.*

Dyeing Materials.

Leaves of *Bignonia Chica*, and red pigment made from them. British Guiana.

Remarkably fine madder-root, and cloth dyed to illustrate its quality, from the Caucasian provinces of Russia.

Leaves of *Memecylon tinctoria* (Ceylon), of *Fraxinus oxyphylus*, and *Lawsonia inermis* from Algeria, and the husks of the black variety of *Sorghum vulgare* from Turkey, Greece, Italy, and Algeria.

Tanning Materials.

Leaves of *Myrtus communis*, *Pistacia Terebinthus*, *P. Lentiscus*, and *Quercus Ilex* from Italy.

Large roots of *Statice Coriaria* from Russia, where they are much used; and galls of *Pistacia Lentiscus* (Turkey), and *Tamariscus indica* (Algeria), called Takaout, and the knotted Hungarian galls, called Knoppern, from Hungary. The last produced by *Cynips quercus-calycis.*

Oils and Oil Seeds.

Oil of Patava or Patua and Bacaba from the palms *Œnocarpus Batava*, and *Œ. Bacaba* (Brazil); Andiroba or Carap oil from *Carapa guianensis* (British Guiana and Trinidad); of the Avocado pear, *Persea gratissima;* the Brazil or Para nut, *Bertholletia excelsa;* of the Tonquin or Tonka bean, *Dipterix odorata;* and the essential oil called sassafras oil, from the stem of *Nectandra Cymbarium*, all from Brazil; the last is yielded in great abundance from wounds in the bark of the growing tree, and is an excellent solvent for resinous gums, &c., in this respect equalling turpentine, with an agreeable odour to recommend it in preference.

From Italy, excellent oils from grape stones, tobacco seed, and walnuts; and from Austria, a remarkable and beautiful oil from maize. A specimen of the seed of *Sesamum indicum*, raised in Austria; and very fine sunflower seed from the Black Sea provinces of Russia.

Miscellaneous.

A curious application of coffee rusks, usually a troublesome waste material in the plantations. In Brazil, one grower has economically applied it to the manufacture of potash, by burning it, and washing the alkaline salts out, and afterwards refining them; the remaining ash is still good manure.

Leaves of *Curatella americana*, prepared by drying, for use in polishing in lieu of sandpaper.

Isca do Mato, a kind of Amadou from Brazil. Also from the same country, Tuari, or the bast of *Lecythis ollaria*, and other species prepared for cigarettes.

A species of gutta-percha from Guiana, called "Ballata," yielded by *Sapota Mullieri*, and promising to be of very great commercial importance.

Some remarkable applications of willow wood from Austria, in the form of mats and clothing; and a remarkable specimen of the wood of *Medicago arborea*, of great weight and density, from Italy.

Thursday, 14*th April.*—Professor BALFOUR, President, in the Chair.

The following Gentlemen were elected Resident Fellows:—

WILLIAM RUTHERFORD, M.D.
JOHN WILSON PATON, Esq.
DAVID YOUNG, Esq.
A. H. ALLSHORN, Esq.

The following donations to the Library were laid on the table:—

Transactions of the Scottish Arboricultural Society, Vol. III., Part I.—From the Society.

Proceedings of the Royal Horticultural Society, Vol. IV. No. 6.—From the Society.

Preceedings of the Agri-Horticultural Society of Madras.—From the Society.

A series of Botanical Labels, published by Messrs Kemp and Co.—From the Publishers.

A Vindication of the Present State of Aural Surgery, by a Member of the New Sydenham Society.—From the Author.

Remarks on the Sexual Changes in the Inflorescence of Zea Mays, by John Scott.—From the Author.

Notice of the State of the Open-Air Vegetation in the Edinburgh Botanic Garden, during December 1863, by J. H. Balfour, M.D.—From the Author.

List of British Ferns and their varieties, by P. Neill Fraser.—From the Author.

La Rèunion de la Société Helvétique des Sciences Naturelles en Aout 1863, by Charles Martins.—From the Author.

Beitrage zur Fossilen und Lebenden Flora, von Dr H. R. Göppert.—From the Author.

The following donations to the Herbarium were announced:—

From Rev. John Baillie and Archibald Hewan, Esq.—Plants from Old Calabar.

From William Brand, Esq.—Parcel of Plants from the Isle of Skye.

The following donations to the Museum at the Botanic Garden were noticod:—

From Rev. John Baillie, Old Calabar.—Fruit of Mimbo Palm, Seeds of Wild Cherry, Soapberries, Kola Nuts, Bitter Kola, Wild

Mango Seed, Garlic, Edaing, Duffa Fruit, Ninkong, used for sweetening water, Gaboon Candle or Torch, Pineapple fibre, Sea Island Cotton, grown at Old Calabar, leaves, flowers, and fruit of the Calabar Ordeal Bean (*Physostigma venenosum*).

From Archibald Hewan, Esq., surgeon, Old Calabar.—Preserved specimens of Strophanthus, sp., Mucuna pods, Araninoi oil, fruit, and seeds, &c.

From Mr Thomas Kerr.—Crocuses with peculiar rhizomes, besides the ordinary corms.

The following Communications were read:—

I. *On the Fertilization and Ripening of Seeds.* By J. Birkbeck Nevins, M.D., Lond., Lecturer on Materia Medica, Liverpool Royal Infirmary of Medicine. Communicated by Dyce Duckworth, M.D., Edin.

This paper was copiously illustrated by coloured drawings—The first part was devoted to showing the arrangements adopted in nature to secure the fertilization of seeds, and prevent the destruction of the pollen by moisture in plants growing in water; and the second part exhibited the changes which take place in the growth of plants during the period of ripening, so as to ensure the perfect accomplishment of this process. After alluding to the position and length of the stamens in erect and pendulous flowers, by means of which the pollen shall always come in contact with the stigma, the great natural food-bearing orders of *Gramineæ*, *Cruciferæ*, and *Leguminosæ* were mentioned as proofs of the importance of studying the dissection of inflorescence. These orders all expand their flowers first below, and gradually upwards, so that if the pollen of the lower flowers should happen to be injured by rain, their ovules may still be fertilized by the pollen which falls upon their stigmas from the flowers above. Attention was called to the great preponderance of this mode of inflorescence above that which expands first at the summit, and gradually descends, and its importance in nature was pointed out with reference to the preservation of the different species.

The special arrangements in water plants for preserving the pollen from injury were illustrated by the spiral and

uncoiling flower-stalk of *Vallisneria spiralis* and *Ruppia maritima*; by the rapid development of air-bladders which occurs in the *Jussiœa repens* during a flood, by means of which the flowering stem is floated above the water; by the constant elongation in the stem of the *Callitriche*, by which the head of flowers is always floating upon the surface; by the water-tight spike of the *Potamogeton*, whilst in and below the water, and by the peculiar and curious structure of its flowers, when the stalk rises above the water. The *Subularia*, which flowers entirely below the water, and the *Elatine Hydropiper*, which is also below the surface, were shown to have fertilized their seeds whilst the flowers were still in bud and perfectly water-tight; and the same remarks applied to the *Zostera marina*.

The changes which take place during the process of ripening the seeds are often associated with the notion of decay; and the drooping heads, the withered leaves and the faded colour of many of the most beautiful plants, do certainly favour the opinion. The object of this division of the paper was, however, to show that these apparent proofs of decay are really processes of growth, and to point out their importance for the perfect ripening of the seeds. Most seeds require both air and light, as well as warmth, during this process; for if they are collected before they are perfectly ripe, and are placed in a warm and dark place from which air is also excluded, they soon become mouldy, instead of ripe; and many of the apparent signs of decay, such as the drooping head, are in reality mere processes of growth by which the seeds may be exposed to air and light, or by which undue access of moisture may be prevented. The following illustrations were given, and they were classed in twos and threes, for the purpose of contrast. For example—

The Poppy has a drooping flower-bud, but a rigidly erect seed-vessel; whilst the Campanulas have a more or less erect flower, but the seed-vessels hang perpendicularly from an abruptly curved stalk. The Poppy capsule opens by valves at the summit, by means of which, air and light are admitted to the seeds, which are kept from falling out by the erect position of the seed-vessel; but the Hare-

bells open by valves at the base of the capsule through which the seeds would fall if it were erect. It is, however, closed at the summit, and the stalk, in ripening, turns abruptly down, so that the seeds are preserved whilst air and light still have access.

Anagallis and *Lychnis.*—In these flowers there is no change of direction in the seed-vessel; for the capsule of the Anagallis is so thin as to offer no obstruction to light, and little to air, whilst its box-like character preserves the seeds from falling out, whatever its position. They ripen, therefore, in every direction, vertical, horizontal, and drooping. The *Lychnis*, on the contrary, has an erect flower and an erect capsule, which opens, like all the Caryophyllaceæ, by teeth at the summit.

American Cowslip, Cyclamen, and *Campanula persicifolia.*—The first has a drooping flower, but an erect seed-vessel, for it opens at its summit. The Cyclamen capsule, however, also opens at its apex—and yet it is drooping; but in this flower the seeds ripen in the earth; and the stalk of the seed vessel *grows* downwards in a curved direction (but does not *droop*), until the apex of the capsule has piercéd the earth, where it opens and deposits its seeds. The *Campanula persicifolia*, unlike the other Campanulas, has an erect seed-vessel, which appears to militate against the view here advocated, until the capsule is examined, when it is found to have its valves at the summit instead of the base. The same purpose is accomplished by the erect capsule in this Campanula, which is gained by the drooping ones in the Order generally.

The Limosella *(Scrophulariaceæ)*, with an erect flower, and a reversed seed-vessel; and the Foxglove (also *Scrophulariaceæ*), with a drooping flower, and an erect capsule. The Hollyhock (*Malvaceæ*), with a flower generally erect, and a withered calyx in autumn, turned abruptly down; and the common Mallow, with both flowers and seeds erect. The Dandelion with an erect flower and erect head of seeds; and the Coltsfoot, (also Composite), with a drooping bud and erect flower; then a drooping head, after withering commences, and at last an erect head again of seeds. The Michaelmas daisy, with an erect head of flowers, and also an erect head of seeds. The African

Marygold with abruptly drooping receptacle at the time of seeding. The *Centaurea nigra*, with a head always erect; and the *Carduus heterophyllus*, with the seeding head drooping—all however, belonging to the same Natural Order.

The Hyacinth, with its flowers drooping and its capsule erect; and the "nodding, nodding, Violet" with its capsule also erect. These and others were shown, and the connection was pointed out between the various positions of their seed-vessels, and their habits of life, the structure of their seed-vessels, or the period of year at which they flower—and it was shown, that whether drooping or erect, and whether uniformly so or not, as in the case of the Coltsfoot, the changes were all connected with the requisites for ripening the seeds, and were stages of growth and not of withering or decay.

II. *On the Accessory Organs of the Hybrid Selaginella, referred to by Mr John Scott, in a paper read before the Botanical Society 10th March* 1864. By Charles Jenner, Esq.

The notice of a Hybrid Selaginella, by Mr Scott, read before this Society at its last meeting, induced in me the desire to examine the minute structures called accessory organs. They are found by Karl Müller, who first observed them, in the axillæ of both sets of leaves in all the Lycopodiaceæ. It appeared to me interesting to know, whether these organs, too, manifested the same hybrid character so carefully noted by Mr Scott, and so well set forth by him in his valuable and interesting paper. The hybrid, you will remember, was raised in the Edinburgh Botanic Garden by Mr Scott, and it was a cross between the macrospores of *Selaginella Danielsiana* and the microspores of *Selaginella Martensii.* Although some writers have regarded these two forms as varieties only of one species, the individuals on the table here, and which are the original plants from which the two sets of spores were taken to raise the hybrid, show a strongly-marked difference, sufficiently strong, indeed, to enable us to note, with all the minuteness one could desire, the intermediate character of the plant

produced by their mutual agency. It would be premature yet to speak of the hybrid, notably marked though it is, even as a persistent variety. The plant, I hope, will thrive and prosper, that it may develope in time healthy reproductive organs; these will no doubt be made the subject of careful growth and observation, and may give us stock marked with its own peculiar characteristics; if it does so, it will encourage more experiments in the same direction, as bases for future generalisation. Such experiments, carefully conducted as this has been, give us facts of the highest importance in botanical physiology, and in the great associated questions which possess such very high interest at the present day. Mr M'Nab kindly afforded me every opportunity to examine the parent plants, and also the hybrid. I have subjected the various organs to minute microscopic inspection; but I can add nothing of moment in regard to them, to the details given by Mr Scott in his paper; the distinctions he has observed are carefully precise. The hybrid manifests, in some particulars, the peculiarities of form, colour, structure, and habit of its nursing-mother plant, in others those of its male progenitor. The accessory organs have been subjected by me to careful microscopic examination, and they show similar structural affinities and differences. Referring to the specimens I have on the table, it will be observed that the organs from *S. Danielsiana* have the short compressed base and spreading border, suggested by the general form and outline of the plant from which the macrospores were derived; that those from *S. Martensii* have a more full longitudinal development, and their borders have the graceful flowery expansion that we observe in that species, while those taken from the hybrid are small and straight, and seem stunted in contour and size, thus corresponding in a very marked degree with the general appearance and character of Mr Scott's hybrid.

In preparing these specimens, I have been careful to take the organs—accessory organs of Müller, but the stipules of Hofmeister—from the axils of leaves occupying the same relative positions on the axes. They are mostly removed from numerically continuous leaves upon axial internodes at equal spaces from the growing point. I have also distinguished those taken from the axils of the *folia*

majora from those of the *folia minora.* Indeed I have taken all the care that the importance of the subject in my regard seemed to require.

III. *Notes on the number of Stomata of some Indigenous and Cultivated Plants in Belgium.* By M. Ed. Morren. Translated by G. M. Lowe, Esq.

It is well known that vegetable tissues communicate with the atmosphere by means of stomata; and that it is by the intervention of these organs that gases and vapours pass in and out of the interior of plants, circulate in the vessels, and dissolve or decompose in the cellular juice. They are most abundant on the leaves, but are also found upon other aerial organs of plants, such as herbaceous stems, perianths, fruits, &c.; they are rare upon underground organs, and are altogether absent upon submerged parts, where, owing to the absence of the epidermis, they are not known to exist,—the whole surface of aquatic plants subserving the office of stomata.

Most elementary manuals are faulty with regard to the true structure of stomata. The two reniform cellules, which, by the contact of their extremities constitute these little mouths, are often surmounted by a fold of epidermis projecting from their edges, which, by drawing itself down, constitutes a little ante-chamber (*Vorhofspalte*), situated above the osteole. There also exists behind the osteole, independent of the pneumatic cavity, a posterior chamber (*Hinterhof*), hollowed out in the parenchyma, corresponding to the stomata.

The organisation of stomata has been elucidated by Hugo von Mohl,* with the habitual sagacity of that celebrated anatomist. The generality of authors agree in stating, that the functions of absorption and exhalation are performed by the stomata. These functions are not known to be carried on in any other part of the more or less thickened or suberose epidermis which covers the whole surface of plants, excepting where it is perforated by stomata. Observation reveals numerous relations between their osteole, pneumatic chamber, intercellular passages of the paren-

* Bot. Zeit. 1856, p. 697. Ann. Sc. Nat. t. vi. 1856, p. 162.

chyma, the aeriferous canals, and the vascular system in general. Upon most dicotyledonous leaves which have a reticulate venation, the stomata are distributed irregularly over the intervening spaces left by the veins; in monocotyledonous parallel-veined leaves, on the contrary, they are arranged in linear series. *Apropos* to this, the following observation may be mentioned:—"M. Unger was one day attempting to inject the air-passages of plants, with the assistance of his pupil Dr Leitgeb, when the idea struck him of insufflating them strongly with air. Holding one end of a leaf of *Allium fistulosum* under water, and blowing in at the other extremity, he saw bubbles of air come out from the whole of the submerged surface, which became more numerous when the pressure was increased. He repeated the same experiment with equal success upon the leaves of *Allium Cepa* and Iris, the stems of Equisetum, Hippuris, and many composite and umbelliferous plants; thus demonstrating in a most simple manner the permeability of the aeriferous canals, and their immediate connection with the stomata."* It is asserted, that it is also through the stomata that fungi penetrate into the parenchyma of organs exposed to their devastations; their mycelium, and especially their sporiferous branches, coming to the light through these openings.

A question which has been much discussed is, whether stomata open or shut under the influence of different stimulants, such as light or darkness, heat or cold, moisture or dryness, &c. If the alternate opening and shutting of stomata was positively proved, a certain periodicity in their functions would be decided. This question, apparently so insignificant, would then have very considerable practical consequences. Most contradictory assertions have been brought forward, but not only are we ignorant of the causes which regulate the opening and shutting of stomata, but even whether these movements really exist.

Sir Joseph Banks asserts that the stomata shut during a dry, and open during a moist season. According to Moldenhauer and Amici, the contrary takes place.

Hugo von Mohl (*loc. cit.*), after his experiments on the stomata of *Amaryllis formosissima*, acknowledged that the

* Bull. de la Soc. Bot. de France, t. v. pp. 155–157.

sphincters enlarged the stomatic osteole by their turgescence, and restricted it by their contraction. But he stated, at the same time, that the sphincters, in consequence of their relation with the neighbouring cellules, had not always freedom of motion. He observed, that the stomata of indigenous orchids, and of the lily, opened under water; those of grasses, on the contrary, shut with great rapidity when placed in similar circumstances. He admits, in short, that the sphincters dilate under the influence of light and heat, and contract in the dark, but doubts whether these two agents favour the opening of stomata.

M. Ad. Weiss,* who is occupied with this interesting problem, denies that stomata have the faculty of opening or shutting alternately; he only acknowledges that the sphincters dilate and contract in contact with water.

We have been occupied several years in investigating the relations which exist between plants and the elements of the atmosphere, and have noted experimentally the influence of gases, in various proportions, which were found normally or accidentally present in the air. These experiments show that noxious gases—sulphurous acid for example—are absorbed by the leaves at night as well as during the day; consequently, we are led to suppose that stomata remain open during darkness. All our experiments lead us to conclude that absorption of air by the leaves takes place by means of stomata; that it is by these openings only that sulphurous acid, mixed with the atmosphere in very small proportions, penetrates into the plant and acts on the parenchyma. Absorption is not effected by the superior surface of leaves when they do not bear stomata; neither does it take place when the inferior surface is covered by an impermeable coat, such as wax. In addition to this, we believe that we have discovered that the energy of absorption is proportional to the number of stomata; in other words, that the sensibility of plants to the action of noxious gases is, for the same natural group, directly proportional to the number of stomata with which the leaves of those plants are provided. This very simple law establishes a relation between the number of stomata of a leaf and the changes which the contact of noxious gases excites in its tissues.

* Bull. de la Soc. Bot. de France, t. v. pp. 123-125.

We have undertaken to determine the number of stomata among a certain number of species. The science possesses but few calculations on this subject,—by Thomson, Lindley, Unger, Kroker, Sprengel, Humboldt, Kieser, &c., relating chiefly to plants not generally known. We have condensed, under the form of a table, the information found disseminated in the different authors. These data have all been reduced to the uniform type of square inch, English or German measure, according to the nationality of the observer.

The contributions of Thomson are those which are found reproduced in part in nearly all the elementary manuals.

TABLE I.—*Older Observations relating to the Number of Stomata.*

No.	Name of Plant.	Name of Observer.	No. of Stomata upon sq. in.		
			Superior Surface.	Inferior Surface.	Total.
1	Abies Picea	Kroker .	...	800	800
2	Agave americana	,,	...	1,560	1,560
,,	— —	Humboldt	...	600	600
3	Alisma Plantago	Thomson	12,000	6,000	18,000
4	Aloe	Lindley	25,000	20,000	45,000
5	Alstrœmeria	,,	...	20,000	20,000
6	Amaryllis Josephinæ . .	Thomson	31,500	31,500	63,000
7	Andromeda speciosa . . .	,,	...	32,000	32,000
8	Arum Dracontium . . .	,,	8,000	16,320	24,320
9	Asclepias Curassavica . .	Kroker .	...	12,000	12,000
10	Brassica Rapa	Unger .	21,564	41,964	63,528
11	Cactus speciosissimus (stem)	Lindley	...	...	15,000
12	Cobæa scandens	Thomson	...	20,000	20,000
13	Crinum amabile	Lindley	20,000	20,000	40,000
14	Daphne Mezereum . . .	Thomson	...	4,000	4,000
15	Dianthus Caryophyllus . .	,,	38,500	38,500	77,000
16	Epidendrum	,,	...	4,800	4,800
17	Gaertnera	,,	1,000	142,750	143,750
18	Hydrangea quercifolia . .	,,	...	160,000	160,000
19	Hypericum grandiflorum .	,,	0	47,000	47,000
20	Ilex	,,	...	63,600	63,600
21	Iris germanica	,,	11,572	11,572	23,144
22	Lilium album . . . . ,	Sprengel	...	1,872	1,872
,,	— —	Kroker	...	3,312	3,312
,,	— —	Edwigh	...	6,924	6,924
23	Mesembryanthemum . .	Lindley	30,000	40,000	70,000
24	Nymphea cærulea . . .	. .	26,592	...	26,592
25	Olea europæa	Thomson	...	57,600	57,600
26	Pæonia	,,	...	57,600	57,600
27	Phaseolus vulgaris . . .	Kieser	...	24,000	24,000

No.	Name of Plant.	Name of Observer.	No. of Stomata upon sq. in.		
			Superior Surface.	Inferior Surface.	Total.
28	Philadelphus coronarius .	Thomson	...	20,000	20,000
29	Pinus halepensis	Kroker	...	228	228
30	Pittosporum Tobira . . .	Thomson	...	160,000	160,000
31	Portulaca oleracea (young leaves)	Kroker	...	12,480	12,480
"	Do. (adult leaves) .	...	...	1,560	1,560
32	Potamogeton natans . .	Unger	7,800	...	7,800
33	Prunus Lauro-cerasus . .	Lindley	...	90,000	90,000
34	Pyrus	Thomson	...	24,000	24,000
35	Rheum palmatum . . .	...	1,000	40,000	41,000
36	Rudbeckia	...	8,000	41,000	49,000
37	Rumex acetosa	...	11,088	20,000	31,088
38	Sempervivum tectorum .	...	10,710	6,000	16,710
39	Sium angustifolium . . .	Unger	8,400	120	8,520
40	Syringa vulgaris	Thomson	...	160,000	160,000
41	Tradescantia	...	2,000	2,000	4,000
42	Tussilago Farfara . . .	...	1,200	12,500	13,700
43	Victoria regia	Unger	21,600	...	21,600*
44	Yucca	Lindley	40,000	40,000	80,000

These numbers do not agree well among themselves, and few general conclusions can be drawn from them. Thus it is shown that the stomata among trees are condensed on the inferior surface of the leaves; and the same condition also exists among many herbaceous plants (such as *Cobœa, Asclepias, Epidendrum, Lilium, Solanum*), whilst among a great number of plants under this category (*Aloe, Amaryllis, Arum, Brassica, Crinum, Dianthus, Iris, Mesembryanthemum, Rheum, Rudbeckia, Rumex, Sempervivum, Sium, Tradescantia, Tussilago,* &c.) stomata are found upon both surfaces, sometimes in equal quantity, sometimes even in greater number upon the superior surface. Floating leaves always have their stomata upon that surface in contact with the air.

M. Duchartre has stated, that no relation exists between the number or size of stomata and the quantity of gas disengaged by the leaves under the influence of light. It is said, besides, that this disengagement does not operate exclusively by the stomata, but also traverses the cellular walls of the dermis and epidermis, which are permeable to gas. But the cuticle does not appear to be penetrated by

* This gives 1,055,838,880 stomata to a single leaf.

these liquids. According to M. Garreau, this membrane is not even endosmotic. Rain-water, dew, and artificial watering, are each absorbed exclusively by stomata.

Our observations and experiments have shown us the unequal sensibility of plants to the noxious influences of certain gases which have been brought in contact with them. We think that absorption of these gases by the leaves is in relation with the number of organs by which absorption operates, that is to say, with the stomata.

Here is the result of our observations, divided into three tables. In the first, the plants are arranged in natural groups; in the second and third they are placed respectively, according to the increase of the number of stomata upon an equal surface of leaf and upon an average leaf.

TABLE II.—*Determination of the Number of Stomata.*

No.	Name of Plant.	Surface of Leaf.	Number of Stomata found at each observation.												Mean.
			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	
	Rosaceæ.														St.
1	Prunus armeniaca,	Inferior, . .	55	58	59	80	58	63	...	...	...	...	...	...	62·160
		Superior, . .	0	0	0	0	0	0	...	...	...	...	...	...	0·000
2	Cratægus Oxyacantha, . .	Inferior, . .	43	43½	35	28	25	39½	...	...	...	...	...	...	35·660
		Superior, . .	0	0	0	0	0	0	...	...	...	...	...	...	0·000
3	Cerasus vulgaris,	Inferior, . .	52	61	64	58	63	55	...	...	...	...	...	...	58·830
		Superior, . .	0	0	0	0	0	0	...	...	...	...	...	...	0·000
4	Cerasus Mahaleb,	Inferior, . .	65	59	57	63	67	76	66	58	59	61	53	56	61·666
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	0	0·000
5	Prunus Laurocerasus, . .	Inferior, . .	36	43	49	30	38	...	...	...	...	...	...	...	39·200
		Superior, . .	0	0	0	0	0	...	...	...	...	...	...	...	0·000
6	Amygdalus persica,	Inferior, . .	38	75	40	32	42	77	...	...	...	...	...	...	50·660
		Superior, . .	0	0	0	0	0	0	...	...	...	...	...	...	0·000
7	Pyrus communis,	Inferior, . .	19	24	21	21	22	30	33	...	...	...	...	...	24·830
		Superior, . .	0	0	0	0	0	0	0	...	...	...	...	...	0·000
8	Pyrus Malus, .	Inferior, . .	41	78	75	63	78	...	...	...	...	...	...	...	67·000
		Superior, . .	0	0	0	0	0	...	...	...	...	...	...	...	0·000
9	Prun. domestica Claudiana, *Pers.*,	Inferior, . .	49	87	102	70	36	82	57	...	...	...	...	...	69·000
		Superior, . .	0	0	0	0	0	0	0	...	...	...	...	...	0·000
10	Rosa damascena,	Inferior, . .	35	25	31	32	26	36	...	...	...	...	...	...	30·830
		Superior, . .	0	0	0	0	0	0	...	...	...	...	...	...	0·000
	Amentaceæ.														
11	Betula alba, . .	Inferior, . .	22	16	13	24	14	16	24	20	21	24	18	19	19·250
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	0	0·000
12	Carpinus Betulus,	Inferior, . .	49	45	36	24	46	52	38	29	54	48	37	44	41·833
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	0	0·000
13	Quercus Robur, .	Inferior, . .	102	116	96	64	112	68	81	102	92	108	109	81	94·250
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	8	0·000
14	Fagus sylvatica, .	Inferior, . .	68	56	84	64	48	58	72	76	52	94	39	60	64·250
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	0	0·000
15	Juglans regia, . .	Inferior, . .	90	91	85	77	76	81	81	90	79	61	63	69	78·583
		Superior, . .	0	0	0	0	0	0	0	0	0	0	0	0	0·000
16	Populus virginiana, *Desf.*, .	Inferior, . .	32	39	41	29	22	18	24	28	20	35	15	46	29·083
		Superior, . .	11	13	12	12	7	15	9	11	7	10	11	16	11·166

TABLE II.—*Continued.*

No.	Name of Plant.	Surface of Leaf.	Number of Stomata found at each Observation. 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Mean.
	Amentaceæ.														St.
17	Populus pyramidalis,	Inferior,	42	41	31	42	36	42	25	42	51	46	44	45	40·583
		Superior,	11	11	9	7	9	11	13	9	12	16	12	14	11·166
18	Populus nigra,	Inferior,	32	33	37	31	34	36	27	32	28	25	32	29	31·333
		Superior,	5	8	6	9	4	6	5	3	5	6	4	4	5·416
19	Populus canescens,	Inferior,	41	52	46	48	44	56	92	84	68	88	49	96	63·666
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
20	Pop. Caroliniana,	Inferior,	24	59	27	29	42	44	42	39	39	47	48	46	40·500
		Superior,	37	26	32	33	29	34	26	18	25	23	11	22	26·333
	Trees, &c.														
21	Acacia Pseudo-acacia,	Inferior,	39	42	36	31	37	34	29	37	32	41	27	32	34·750
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
22	Buxus sempervirens,	Inferior,	37	38	39	39	32	...	...	...	...	...	...	...	37·000
		Superior,	0	0	0	0	0	...	...	...	...	...	...	...	0·000
23	Fraxinus excelsior,	Inferior,	41	39	52	54	37	34	34	48	39	45	56	44	43·583
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
24	Ilex Aquifolium,	Inferior,	44	41	43	43	41	...	...	...	...	...	...	...	42·400
		Superior,	0	0	0	0	0	...	...	...	...	...	...	...	0·000
25	Hedera Helix,	Inferior,	49	46	56	56	54	59	...	...	...	...	...	...	53·330
		Superior,	0	0	0	0	0	0	...	...	...	...	...	...	0·000
26	Syringa vulgaris,	Inferior,	53	40	79	75	62	...	...	...	...	...	...	...	61·800
		Superior,	0	0	0	0	0	...	...	...	...	...	...	...	0·000
27	Philadelphus coronarius,	Inferior,	23	25	25	21	...	...	...	...	...	...	...	...	23·500
		Superior,	0	0	0	0	...	...	...	...	...	...	...	...	0·000
28	Vitis vinifera,	Inferior,	36	42	46	47	34	42	26	40	56	43	48	46	42·167
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
	Herbaceous Plants.														
29	Beta vulgaris,	Inferior,	32	30	29	32	31	31	31	29	34	33	34	30	31·333
		Superior,	18	13	17	16	19	19	20	27	22	26	23	25	20·416
30	Faba vulgaris, var. equina,	Inferior,	21	16	26	18	18	21	21	16	15	16	17	20	18·750
		Superior,	9	10	9	9	12	11	10	7	11	10	11	13	10·166
		Surface of Stipules, Inferior,	6	5	7	6	6	8	12	15	17	17	13	19	10·083
		Surface of Stipules, Superior,	2	3½	4	4	1	2	5	3	4	4	2	4	3·208
		Epidermis of the Stalk,	0	2	3	3	1½	2	0	1	2	4	0	2	1·708
31	Helianthus annuus,	Inferior,	72	59	67	58	64	61	76	68	73	66	65	63	66·000
		Superior,	42	36	44	35	39	34	37	33	37	35	37	39	37·333
32	Humulus Lupulus,	Inferior,	71	85	78	72	69	88	68	64	46	66	67	63	69·750
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
33	Apium Petroselinum,	Inferior,	33	30	28	35	32	33	31	36	42	30	35	40	33·750
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
34	Solanum tuberosum,	Inferior,	68	68	52	84	72	92	69	84	54	76	62	80	71·750
		Superior,	0	0	0	0	0	0	0	0	0	0	0	0	0·000
35	Trifolium pratense,	Inferior,	82	74	85	108	88	92	76	96	84	104	92	115	91·330
		Superior,	64	68	63	68	60	56	36	60	43	68	44	48	56·500
		Epidermis of the Stalk,	15	24	16	15	18	15	16	18	19	11	18	14	16·583
	Cereals.														
36	Avena sativa,	Inferior,	6	6½	8	8	8	9	7	7½	8	8	6	5	7·250
		Superior,	11	13	10	11	9	12	9	11	12	10	13	10	10·916
		Exterior, of Sheath,	9	7	12	11	8	9	11	11	10	5	7	8	9·000
		Interior, of Sheath,	2	3	0	1	4	1	3	1	2	3	1	0	1·750
		Epidermis of Stem,	11	8	9	12	14	12	10	11	13	15	12	15	11·833
		Exterior of Glume,	5	4	7	6	6	5	9	11	3	6	5	10	6·417

TABLE II.—*Continued.*

No.	Name of Plant.	Surface of Leaf.	Number of Stomata found at each Observation. 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Mean.
	Cereals.														St.
37	Triticum sativum,	Inferior, . .	7	10	8	10	5	10	5	12	11	9	8	9	8·666
		Superior, . .	14	12	13	14	10	12	12	16	11	9	17	13	12·750
		Exterior, of Sheath,	10	8	11	14	8	9	13	11	12	8	9	8	10·083
		Interior, of Sheath,	0	1	0	2	2	1	0	0	1	0	0	1	0·666
		Epidermis of Stem, . .	12	10	14	17	15	9	13	12	18	10	12	10	12·666
		Exterior of Glume, .	18	13	9	14	7	13	5	16	13	13	17	13	12·750
38	Secale cereale, .	Inferior, . .	13	12	12	10	9	8	10	13	10	14	13	12	11·333
		Superior, . .	9	9	10	14	11	18	16	13	14	12	19	15	13·333
		Exterior, of Sheath,	10	11	9	11	10	10	9	5	10	8	9	8	9·166
		Interior, of Sheath,	2	3	1	0	2	1	1	3	0	2	0	2	1·416
		Epidermis of Stem, . .	12	10	11	17	19	10	11	15	9	15	23	14	13·833
		Exterior of Glume, .	9	7	8	7	12	10	8	8	9	13	8	6	8·750

TABLE III.—*Determination of the Number of Stomata comprised in a Square Millimetre* of Surface.*

No.	Name of Plant.	Surface of Leaf.	Mean in Square Millim. of Surface.	Mean in Square Millim. upon both Surfaces of Leaf taken together.	Simple relation of the Numbers of the preceding Columns.†
			St.	St.	
1	Avena sativa, . . .	Inferior, .	26,607	66,669	0,773
		Superior, .	40,062		
2	Betula alba, ...	Inferior, .	70,648	70,648	0,819
		Superior, .	0,000		
3	Triticum sativum, . .	Inferior, .	31,804	78,596	0,899
		Superior, .	46,792		
4	Philadelphus coronarius,	Inferior, .	86,245	86,245	1,000
		Superior, .	0,000		
5	Secale cereale, . . .	Inferior, .	41,692	90,624	1,049
		Superior, .	48,932		
6	Pyrus communis, . .	Inferior, .	91,130	91,130	1,050
		Superior, .	0,000		
7	Faba vulgaris, var. equina, ...	Inferior, .	68,812	106,121	1,230
		Superior, .	37,309		
8	Rosa damascena, . .	Inferior, .	113,140	113,140	1,310
		Superior, .	0,000		
9	Apium Petroselinum, .	Inferior, .	123,863	123,863	1,436
		Superior, .	0,000		
10	Acacia Pseudo-acacia,	Inferior, .	127,532	127,532	1,478
		Superior, .	0,000		
11	Cratægus Oxyacantha,	Inferior, .	130,870	130,000	1,510
		Superior, .	0,000		

* The English inch corresponds to 25 millimetres.

† *Philadelphus coronarius* is taken as unity.

TABLE III.—*Continued.*

No.	Name of Plant.	Surface of Leaf.	Mean in Square Millim. of Surface.	Mean in Square Millim. upon both Surfaces of Leaf taken together.	Simple relation of the Numbers of the preceding Columns.
			St.	St.	
12	Buxus sempervirens, .	Inferior, . Superior, .	135,790 0,000	135,790	1,570
13	Populus virginiana, .	Inferior, . Superior, .	106,734 40,979	147,713	1,712
14	Vitis vinifera, . . .	Inferior, . Superior, .	154,753 0,000	154,753	1,794
15	Ilex Aquifolium, . .	Inferior, . Superior, .	155,608 0,000	155,608	1,800
16	Fraxinus excelsior, .	Inferior, . Superior, .	159,950 0,000	159,950	1,854
17	Amygdalus persica, .	Inferior, . Superior, .	185,922 0,000	185,922	2,150
18	Populus pyramidalis, .	Inferior, . Superior, .	148,939 40,979	189,918	2,202
19	Beta vulgaris, . . .	Inferior, . Superior, .	114,992 94,927	189,919	2,270
20	Hedera Helix, . . .	Inferior, . Superior, .	195,720 0,000	195,720	2,500
21	Cerasus vulgaris, . .	Inferior, . Superior, .	215,900 0,000	215,900	2,224
22	Syringa vulgaris, . .	Inferior, . Superior, .	226,806 0,000	226,806	2,629
23	Populus canescens, .	Inferior, . Superior, .	233,654 0,000	233,654	2,709
24	Fagus sylvatica, . .	Inferior, . Superior, .	235,798 0,000	235,798	2,734
25	Pyrus Malus, . . .	Inferior, . Superior, .	245,890 0,000	245,890	2,850
26	Prunus domestica Claudiana, . . .	Inferior, . Superior, .	253,230 0,000	253,230	2,930
27	Humulus Lupulus, .	Inferior, . Superior, .	255,982 0,000	255,982	2,968
28	Solanum tuberosum, .	Inferior, . Superior, .	263,323 0,160	263,483	3,055
29	Juglans regia, . . .	Inferior, . Superior, .	288,899 0,000	288,899	3,348
30	Quercus Robur, . .	Inferior, . Superior, .	345,898 0,000	345,898	4,010
31	Helianthus annuus, .	Inferior, . Superior, .	242,220 137,012	379,232	4,397
32	Trifolium pratense, .	Inferior, . Superior, .	335,181 207,355	542,536	6,290

TABLE IV.—*Number of Stomata on an Average Leaf.*

No.	Name of Plant.	Absolute Surface of an Average Leaf.	Surface of the principal Veins of a Mean Leaf.	Surface of an Average Leaf deducting the principal Veins.	Number of Stomata on an Average Leaf*
		Square Cent.	Square Millim.	Square Cent.	Stomata.
1	Buxus sempervirens,	1·50	20	1·30	17,553
2	Rose (leaflet), . . .	4·00	45	3·55	40,165
3	Acacia (leaflet), . .	3·72	21	3·51	44,764
4	Betula alba, . . .	15·00	112	13·88	98,059
5	Cratægus Oxyacantha,	10·69	130	9·39	122,887
6	Secale cereale, . .	18·00	,,	18·00	162,943
7	Ilex Aquifolium, . .	12·00	60	11·40	177,393
8	Triticum sativum, .	25·00	,,	25·00	196,490
9	Philadelphus coronarius, . . .	29·00	120	27·80	239,761
10	Carpinus Betulus, .	19·00	180	17·20	264,066
11	Populus nigra, . .	23·89	107	22·82	307,771
12	Solanum tuberosum,	16·00	160	14·40	379,416
13	Prunus armeniaca, .	19·50	135	18·15	414,090
14	Syringa vulgaris, . .	21·00	90	20 10	455,880
15	Humulus Lupulus, .	44·00	210	41·90	1,072,565
16	Quercus Robur, . .	39·00	193	37·07	1,282,244
17	Vitis vinifera, . . .	94·00	420	89·89	1,389,682
18	Beta vulgaris, . . .	221·00	1,600	205·00	3,893,340
19	Helianthus annuus, .	171·93	500	166·93	6,330,520

We have employed for our observations a magnifying power of 300 times. This power gave us a very clear image, of which the real surface was approximately one-fourth of a square millimetre. The field of the microscope, estimated by the aid of the micrometer and calculation, was found to be comprised 3·67 times in a square millimetre. Thus, by multiplying the number of stomata found during a series of observations by 3·67, the number of stomata comprised upon the square millimetre of leaf surface was obtained. We have no doubt that the stomata are the organs of absorption and exhalation of aeriform fluids ; and we believe that the energy of these functions is proportional to the number of organs which perform them. The importance of stomata is not estimated by their size ; the smallest accomplish generally the most important organic phenomena. Thus it is that the operation of counting the stomata may give rise to most interesting deductions.

* *Leaflet*, where the leaf is compound.

IV. *Notes on the Isere* (Physostigma venenosum) *Moth.* By ARCHIBALD HEWAN, Esq., Surgeon. Communicated by Mr WILLIAM RAMSAY M'NAB.

MANY beans, apparently sound, and others obviously unsound, presented one or more small holes, and when opened, were found to contain larva at various stages of growth. The number of caterpillars in a single bean varied, some containing as many as four. A few of the beans had been eaten to the shell, while others were only partially devoured; the portion of bean still untouched being, however, perfectly fresh. The interior is filled with the excrements glued together by silky threads of the grubs spinning. In the space of a day, an astonishing quantity of these excrements is thrown out at the hole in the bean. In some of the beans pupa were found which were put into a box, and their metamorphosis observed. In a few days four or five moths were found in the box. The insects that have been metamorphosed within the bean escaped through holes wonderfully small in comparison with the size of the insect, and the empty case is frequently found in the hole as if pulled half through by the insect in its attempt to escape into free life. The wings of the newly-escaped moth presented a curious appearance. They were curved in on the back of the insect, seemed considerably shorter than the abdomen, and reminded one of the wings of a chicken without the long wing feathers. After a few minutes, the wings were seen straightened out at full length and standing vertical to the abdomen; in a few minutes more, the wings were seen horizontal and in their natural position. Before the wings were thus expanded, the insect on being touched took *long leaps*. The moth seems to be one of the *Tineina*. The excrements of the grub were picked up by some chickens, and they all died shortly after from the effects of the poison. This is interesting, showing that the physiological action of the poison is unchanged by being digested by the creature; and further, that as the Calabar bean acts throgh the *spinal cord*, it is inert as a poison on those creatures whose nervous system cannot be considered as homologous to a spinal cord. By the use of this and other poisons, many interesting observations might be made on animals, tending to assist in the discovery of homologies and analogies.

V. *List of Plants in Flower in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

	1864.	1863.
Symplocarpus fœtidus, ...	March 14	Feb. 15
Scilla bifolia cærulea, ...	... 18	... 28
Muscari botryoides, ...	... 20	... 20
Scilla bifolia major, ...	... 20	......
Narcissus minimus, ...	... 21	......
pumilus, ...	... 21	March 8
Erythronium Dens-canis, . . .	... 22	... 4
Scilla sibirica, ...	... 25	... 10
Draba aizoides, ...	... 26	... 4
Scilla bifolia alba, ...	... 26	... 4
Daphne Mezereum, ...	... 27	Feb. 16
Puschkinia scilloides, ...	... 29	March 9
Sisyrinchium grandiflorum album,	... 29	......
Corydalis nobilis, ...	... 30	... 11
Scilla bifolia rubra, ...	... 30	... 10
Narcissus odorus, ...	... 31	......
Primula nivalis, ...	April 1	... 8
Corydalis tuberosa, ...	... 2	......
Narcissus Pseudo-Narcissus, . .	... 2	... 28
Corydalis bulbosa, ...	... 4	......
solida, ...	... 6	... 24
Narcissus moschatus, ...	... 8	... 25
Ornithogalum exscapum, . . .	... 8	......
Fritillaria imperialis, ...	... 9	... 22
Hyoscyamus physaloides, . . .	... 9	......
Scopolia, ...	... 9	... 12
Iris reticulata, ...	... 9	......
Ornithogalum montanum, . . .	... 9	......
Pulsatilla vernalis, ...	... 9	......
Hyoscyamus orientalis, . . .	... 11	... 12
Anemone nemorosa, ...	... 12	April 2
Carex montana, ...	... 12	......
Narcissus Jonquilla, ...	... 12	......
Ribes sanguineum, ...	Standard Plants, April 12 Wall Plants. April 1	March 2
Anemone ranunculoides, . . .	... 13	......
Pulmonaria virginica.	... 13	......
Sanguinaria canadensis, . . .	... 13	......
Scilla italica, ...	... 14	......
Saxifraga virginiensis, ...	... 14	... 18
Adonis vernalis, ...	... 14	April 7

Thursday, 12*th May* 1864.—Professor BALFOUR, President, in the Chair.

The following Donations to the Library were laid on the table:—

Proceedings of the Royal Society of Edinburgh, 1863–64.—From the Society.

Proceedings of the Royal Horticultural Society of London, vol. iv. No. 7.—From the Society.

The following Donations to the Museum at the Botanic Garden were noticed:—

From Mr Saleebey.—Cone of cedar, walnuts, raisins, and Indian corn.—From Mount Lebanon.

From Messrs Carstairs.—Fruit of Luffa, &c.

From Mr S. C. Mackenzie.—Leaves of Neem tree (*Melia Azadirachta*), used at Calcutta for preserving books from insects.

From Mr William J. M'Kay, jun.—Model in wax of *Omphalodes verna*.

From Mrs Dr Miller.—Pod of *Cathartocarpus Fistula*, and fibres from the west coast of Africa.

The following Communications were read:—

I. *Notice of Botanical Excursions in Autumn* 1863. By Professor BALFOUR.

Professor Balfour gave an account of an excursion to Clova with a party of eighteen in August 1863, and enumerated the chief plants gathered, illustrating the communication by specimens both in a living and a dried state. He also gave an account of excursions last autumn to Ben Lawers, Meal Ghyrdy, Stobinnain, Stuckachrone, and Ben Voirlich, and noticed the principal plants collected. On Stobinnain he found *Draba rupestris* in considerable abundance.

II. *Notice of the Principal Plants growing in the Botanic Garden, Brisbane, Queensland.* Communicated by Mr JOHN SADLER.

The Brisbane Botanic Garden seems to be gradually growing in usefulness, beauty, and size, under the able superintendence of Mr Walter Hill, who at one time was connected with the Edinburgh Botanic Garden. It is somewhat smaller than the gardens of Sydney and Melbourne; but as regards beauty and variety, it seems to be equal to either. Its situation is on the banks of the Brisbane, which flows along its eastern boundary, and there is a fine green sloping bank from the principal promenade to the water's edge, which is shaded by large bunya trees (*Araucaria Bidwillii*).

Nearly at the extreme southern end of the gardens are some fine varieties of the orange tree, all of which are thriving well. There are also some healthy-looking mango plants at present (October) in fine flower, which give promise of producing abundance of fruit. Immediately adjacent to the residence of the director are some magnificent creeping plants; one of the most beautiful of which at present in flower is the *Bougainvillæa spectabilis;* others equally beautiful are the *Thunbergia laurifolia* and *Harrissii*, both in flower. Adjacent to a bed of Azalea is a collection of Camellias, and near them is a very fine specimen of *Arbutus Unedo*, or strawberry tree of Ireland, which appears to thrive equally well amidst the tropical plants by which it is surrounded in the Botanical Garden as in its native soil. Another very magnificent plant is the *Franciscea*, a native of Brazil, the flower of which varies in colour from white to lilac, and emits a powerful and delicious perfume. It is interesting to observe the English oak and holly, and the banana, fig, and olive, all growing in the same plot, not far from a clump of majestic bamboos which fringe the miniature lake near the centre of the garden. China is represented in camellias, the magnolia, and the rice paper plant. An extensive rosary exists in this garden. We also meet with the logwood tree, the jaca, the teak, the tamarind, and the cinnamon.

Not only has the garden been made attractive as a place

of summer resort for visitors, but the director has had an eye to the advancement of the more material interests of the colony, by making repeated and successful experiments in the way of growing the sugar cane, the coffee plant, the tea plant, tobacco, ginger, *Cinchona Calisaya*, the cotton, the Paraguay tea tree, and many other useful plants.

With regard to the cultivation of the sugar cane, we are informed by Mr Hill that it thrives well, and the result of his experiment shows that the amount of profit to be derived from its cultivation and manufacture is calculated to exceed that of any other production of the colony.

The experiment with the coffee plant has been equally successful. It was originally raised from seed obtained from Captain Wickham's grounds at Newstead, and was planted some five years ago. The plant is at present (October) in full bearing, and the berry is fine and well-flavoured. The plant has been inspected at various times by experienced coffee planters of Ceylon, all of whom agree in asserting that it flourishes well. In Ceylon, two pounds and a half weight from one plant is reckoned a very fair average yield, but it is expected that the one plant growing on the eastern side of the director's house will yield from seven to nine pounds.

There are two plantations of the Tea, consisting of several hundred plants, one looking towards the east, and the other with a western aspect. The plant thrives well in both situations.

One of the newest and most important plants experimented on is the *Cinchona Calisaya*. The plant was introduced in the early part of 1862, and it seems to take kindly to the soil, and is increasing in size and value.

From repeated experiments, Mr Hill is decidedly of opinion that the cultivation of cotton is more likely to prove remunerative should the seed be put in annually, the necessary amount of labour being less than by the plan generally adopted, and the yield much greater. The tobacco plant also succeeds, and, properly cultivated, cannot fail to repay the amount of labour and capital expended on its cultivation. The plants in the Botanic Garden are in splendid condition, and thrive well without more attention being bestowed upon them than merely preventing the en-

croachment of weeds. The ginger plant has been successfully cultivated, as well as two species of arrowroot. The allspice and cinnamon trees, the former from the West Indies, the latter from Ceylon, are each thriving remarkably well. The planting of two or three cinnamon trees, in odd corners, by the agriculturist who grows produce more in demand, would doubtless be found to be a profitable speculation. A new plantation of cinnamon has been formed during the past season, the whole of the young plants in which are coming on well. There is every prospect that in a very short time a fair crop of this much-prized spice will be obtained, and will be of value more than sufficient to repay its cost of cultivation. There are many other useful plants, such as the indigo, the gamboge, the American sarsaparilla, and the Paraguay tea tree, which have been successfully tried.

We must call attention to the museum, which is in course of formation by Mr Hill. The largest room attached to his house is devoted to the purpose, and is fitted with glass cases containing polished specimens of upwards of 130 different woods of the colony. They are, in fact, duplicates of those procured by Mr Hill for the great International Exhibition, where they were adjudged to be superior to any collection of timber sent from any other place, and a very high encomium was passed upon the gentleman to whose untiring efforts its collection and proper preparation was due. Besides the specimens of wood, there are different varieties of gum extracted from trees indigenous to the colony, together with a very fine specimen of that valuable fibrous plant, the *Sida retusa*, and other objects of interest. Attached to the museum is a botanical library, open to visitors, containing something like a hundred and fifty volumes of valuable botanical works.

III. A letter was read from Mr J. M'Kay, dated Madras, 28th January 1864, to Mr M'Nab, in which he gave an account of his journey from Southampton to Madras. He referred particularly to the flora of Ceylon, and gave a brief account of his ascent of the Dodabetta peak on 14th January 1864.

IV. *Notice of the First Horticultural Show at Petermaritzburg, Natal.* By Mr G. M. Lowe.

V. *Notice of a New Variety of Athyrium Filix-fœmina.* By Mr John Sadler.

In February 1863, while at Alloa, I obtained from Mr Dawson and Mr Paterson, dried fronds of a singularly beautiful variety *Athyrium Filix-fœmina*, a living plant of which I now exhibit. I was informed that it had been collected in 1862 by a young gentleman, Mr James Cosh, in a wild state by a roadside in Stirlingshire, near Loch Lomond.

In the spring of last year I sowed a few of the spores, some of which germinated, and are now mostly thriving young plants, but as yet showing no marked symptoms of their parent's peculiarity. As I could find no description in Moore's "British Ferns" answering to my plant, I transmitted the fronds to that gentleman, when he wrote me as follows:—"The variety of *Filix-fœmina* is quite new, so far as I know, and is a very beautiful one. As a queen amongst lady ferns it would well bear to be called *Victoriæ*." Accordingly it is published under this name in Mr Fraser's List of British Ferns and their Varieties, recently issued.

The fronds are from 10 to 18 inches in length, and crested at the apex. The pinnæ are also crested, and, instead of being single as in all the other varieties, they leave the rachis in pairs, and at such an angle, that each alternate pair overlaps the other so as to give a beautiful plaited appearance to the whole fronds.

VI. *Notice of Additions to the Cryptogamic Flora of Edinburgh.* By Mr J. Sadler.

Tortula aloides, B. et S.—Queen's Park, January 1864. Mr John Brown.

Grimmia orbicularis, variety.—Queen's Park, January 1864. Mr John Brown.

Specimens of this moss, which I received from Mr Bronw, were transmitted to Mr Wilson, who writes,—"The

Grimmia from the Queen's Park is certainly not *G. pulvinata.* I believe it to be a form of *G. orbicularis.* It may be an intermediate species not yet designated. The moss differs from the normal state of *G. orbicularis,* in the oblong (not orbicular) capsule, and more opaque peristome, the teeth of which are scarcely at all cribrose—operculum somewhat rostellate. In other respects it does not sensibly differ from true *G. orbicularis,* and I believe I have specimens of that species from a wall top near Conway, with the peristome equally abnormal, and the capsule more globular, thus connecting your moss with *G. orbicularis.*

"At Conway Castle, *G. pulvinata,* var. β *obtusa,* is found, but this quite distinct from yours in the operculum, which has a deep red border, and in the pale sunken groove surrounding the base of the peristome where the large annulus is lodged, during the attachment of operculum."

Jungermannia hyalina, Lyell; Hawthornden. *J. riparia,* Tayl.; Roslin, Fife. *J. cordifolia,* Hook.; Pentland Hills, West Lomond, Fife. *J. julacea,* Lightf.; Lomonds, Ochils. *J. setiformis,* Ehrh.; Pentland Hills, rare, Dr Carrington. *J. curvifolia,* Dicks.; Ochils. *J. minuta,* Crantz; Pentlands. *J. furcata,* L., γ *æruginosa,* Hook.; Pentlands, Hawthornden.

VII. *Notice of the present condition of the plants which flowered in the Royal Botanic Garden in December* 1863. By Mr M'Nab, Curator.

The high temperature experienced during the months of November and December caused many of the spring flowering plants to be in advance of previous years. Had the spring of 1864 gone on as mildly, little or no injury to vegetation would have been sustained. The long black frosts experienced during January and February, however, seriously damaged the health and flowering of some of the early excited plants. From the 1st to the 15th January the thermometer during the night never rose above the freezing point. On the morning of the 10th it stood at 11° Fahr. During February, with the exception of the 14th,

15th, 16th, and 29th, it fell below the freezing point every night—the lowest being on the 24th, when it reached 14°.

The following is a list of the spring flowering plants noticed as being in bloom during December 1863, with remarks on their after condition:—*Eranthis hyemalis, Hepatica triloba, Viola odorata, Cydonia japonica, Potentilla Fragariastrum, Dondia Epipactis, Erica herbacea, Gentiana acaulis, Primula elatior, Primula veris, P. vulgaris, Galanthus nivalis, Muscari racemosum, Knappia agrostidea.* On the above fourteen species, no difference was observable when the general flowering period came round. By being long retarded, and not subjected to after spring frosts, the general blooming of each species was fully above the average.

Helleborus abschasicus, H. olympicus, H. purpurascens.—The chief flowering period of these plants was over before the severe black spring frost set in. The flowering stems show little or no symptoms of producing seeds, proving that the excited flower stems had been injured when passing out of bloom.

Aubrietia grandiflora.—Many of the plants were killed, particularly those divided during the months of September and October.

Orobus cyaneus, O. vernus.—All the early flowering shoots were totally destroyed; this, however, did not affect the general blooming during April and May.

Doronicum caucasicum.—All the shoots which flowered early were destroyed. The general flowering was not affected.

Petasites fragrans.—All the flowering buds, and those in various stages of development, were wholly destroyed, so much so, that no after flowering was produced. The leaves were not affected.

Petasites nivea.—All the buds expanded during December were injured. Numerous other heads were afterwards produced, and all were fully matured.

Rhododendron atrovirens.—Although all the plants were tolerably full of bloom during December, the general flowering in March was scanty in proportion.

Rhododendron Nobleanum.—Buds of all the very early Nobleanum hybrids were destroyed during the frosts of

February, unless the buds happened to be in a position protected by the leaves.

Phlox verna.—All the early flowering shoots were destroyed. New flower stems were afterwards produced in abundance, but did not bloom before the 3d of May.

Anchusa sempervirens.—All the soft early flowering shoots were totally destroyed.

Omphalodes verna.—The general spring flowering was late, and the blooms much below the average.

Symphytum caucasicum, S. tauricum.—All the early flowering shoots, about twelve inches in height, were entirely killed. They were soon succeeded by others, which flowered abundantly, although several weeks later than usual.

Primula denticulata.—Every plant had the flower-stems from 2 to 3 inches in height, having numerous blooms expanded on each. The frost destroyed all the stems, which ultimately rotted the crown of the plants. Most of the plants were divided early in October. Nearly the entire stock has been destroyed.

Corylus Avellana.—Most of the catkins suddenly became brown, being at the time in full flower.

Sisyrinchium grandiflorum.—The general flowering of the purple variety was very much decreased, not showing one-half the bloom of previous years; while the white variety, which did not show any symptoms of blooming before the end of March, flowered abundantly.

Mr M'Nab submitted the following list of palms at present in flower and fruit in the Royal Botanic Garden, Edinburgh, May 1864:—*Sabal umbraculifera, Euterpe montana, Livistona chinensis, Astrocaryum Ayrii, Phœnix sylvestris, Geonoma multiflora, Chamærops Palmetto, C. Fortuni, C. humilis, C. humilis* var. *arborescens, Seaforthia elegans, Chamædorea Hartwegii, C. gracilis, Harina caryotoides, Chamærops cubensis, Astrocaryum Mexicanum.*

Professor Archer exhibited several interesting Materia Medica specimens from the Industrial Museum.

Mr J. Sadler exhibited living plants of *Cardamine pratensis*, double flowering variety. The plants had been grown from buds formed at the base of leaflets, and had their flowers completely double. In several instances the axis

was not only prolonged beyond the first flower, and produced a second, but frequently continued to grow, and give rise to a bud at its extremity, which ultimately became developed into an independent plant.

Professor Balfour exhibited a set of dried leaves taken from an ivy tree, presenting a great variety of different forms; also a series of dried leaves exhibiting autumnal tints of various shades.

Dr Lowe, Balgreen, exhibited specimens of *Narcissus Pseudo-narcissus* with double white flowers.

Messrs Lawson and Son presented cones of *Juniperus Oxycedrus*, *J. drupacea*, and *J. attica.*

Dr Greville sent specimens of *Erica herbacea*, with white and pink flowers on the same plant.

9th June 1864.—Professor BALFOUR, President, in the Chair.

The following Donations to the Library were laid on the table:—

Proceedings of the Royal Horticultural Society, Vol. IV., No. 8.—From the Society.

An Enumeration of the Species of Acanthaceæ, from the continent of Africa and the adjacent islands, by Thomas Anderson, M.D.—From the author.

Flora of Behar and the Mountain Parasnath, with a list of species collected by Messrs Hooker, Edgeworth, Thomson, and Anderson, by Thomas Anderson, M.D.—From the author.

Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlande und Westphalens, 1863.—From the Society.

Norges Flora af M. N. Blytt, part 1.—From the University of Christiania.

Det Kongelige norske Frederiks Universitets Stiftelse fremstillet i anledning af dets Halvhundredaarsfest, af M. J. Monrad. —From the Royal University of Christiania.

Norste Plantenovne, af F. Aafen.—From the Same.

Supplementer til Dovres Flora, af F. Hoch.—From the Same.

The following Donations to the Museum at the Botanic Garden were noticed:—

From Mr John Thomson.—Specimens of the Jew's Ear Fungus (*Exidia Auricula Judæ*).

From Peter White, Esq., surgeon, Midcalder. Dissections of five genera of plants (framed).

From Dr M'Rae.—Oranges said to be the produce of trees grafted on the laurel, at Teneriffe.

The following Communications were read :—

I. *Recent Botanical Intelligence.* By Professor Balfour.

He first noticed the experiments of M. Gris and M. Dalimier in regard to the vessels of plants. The former showed that glucose was present in the vessels, and the latter that in their perfect state the spiral vessels contained air. M. Cloez and M. Gratiolet found that the gas exhaled from aquatic plants exposed to light in ordinary water slightly impregnated with carbonic acid, contains, besides oxygen, a notable quantity of nitrogen. M. Cloez also states that the coloured parts of plants do not decompose carbonic acid.

M. Belhomme finds that in dicotyledons pollen grains may preserve their fertilising property from a period varying from one to three years, and monocotyledons even to six years.

Dr Asa Gray is satisfied that the two genera Astragalus and Phaca must be united, and that the genus Phaca must be merged in Astragalus. It is in the botany of America that the distinction between Phaca and Astragalus is most pressing, and where the data for the answer are most largely to be found. While extra-tropical Asia is the focus of true Astragalus, that of Phaca is in America, mainly in North America, with an extension along the Andes into South America. While the flora of the Russian empire enumerates 168 species of Astragalus (of which more than nine-tenths are bilocellate or nearly so), and only six species of Phaca, Dr Gray recognises in a paper read to the American Academy of Arts and Sciences, sixty-six species of the Phaca series, and fifty-two of Astragalus proper. Moreover, rather less than half of the latter are completely bilocellate by a dorsal septum, and at least half-a-dozen of different groups have been or might be referred to Phaca. Dr Asa Gray concludes, that Phaca must be merged in Astragalus, and that, since in, perhaps, the majority of Phacæ, there is no intrusion nor peculiar tumidity of the

seminiferous suture, the subtribe Astragaleæ of De Candolle has no valid foundation, so that Astragalus is merely a genus of the Galegeæ.

In a paper on the variability of the pear by M. Decaisne, given in the "Annales des Sciences Naturelles," the author maintains that there is no evidence of the degeneration of our fruit trees in consequence of the continual propagation by grafting. The facts stated by those who contend for degeneration may be explained in various ways—such as climates or soils unsuited for the particular wants of the varieties, bad culture or improper grafting. Our ancient pears, so justly esteemed for a century or two, are still the same as they were at first. The Crassane, Saint Germain, Doyenne, Chaumontel, Bon-Chretien, &c., have lost none of their qualities. If they are neglected, it is only because cultivators are looking after novelties. M. Decaisne also maintains that it is not true that the seeds of good varieties of fruit when sown in ordinary soil, have a tendency to go back to a wild state and produce crab-fruit.

From a paper by A. J. Malmoren, translated in Seemann's Journal of Botany, it appears that the Phanerogamic Flora of Spitzbergen contains 95 species of plants.

Professor Balfour also called attention to papers by M. Leo Lesquereux and Professor Dawson, on the fossil plants of the coal formation, and the Devonian epoch of North America.

II. *Remarks regarding the use of the Betel-nut.* By Professor ARCHER.

Professor Archer described the manner in which the betel-nut is prepared and used in the East, as a masticatory, illustrating his remarks by a series of preparations from the Industrial Museum. The betel-nut is the produce of *Areca Catechu*, a palm of considerable size. It is estimated that upwards of fifty millions of the human race chew the nut.

III. *Notice of New Station for* Corallorhiza innata *near Edinburgh.* Communicated by Professor BALFOUR.

Corallorhiza innata has of late years disappeared from several places around Edinburgh from drainage, but recently

it has been discovered by Mr E. V. Sandilands in considerable quantity in boggy ground on the north-western side of the west Dalmahoy Hill. Specimens were shown in a living state. Professor Balfour also remarked that notwithstanding the numerous botanists who collected plants in Scotland, there were very few, if any instances of stations being destroyed by them. The injury caused had been chiefly by those who collected plants (especially ferns) for sale. Many of these collectors came from England, where the mania for ferns was excessive. He maintained that the recent remarks made as to the destructive propensities of Scotch botanists were erroneous, and must have been written by some one who knew nothing of the facts of the case.

IV. *Letter from Mr William Bell, Saharunpore, dated* 17*th March* 1864. Communicated by Professor Balfour.

I delayed answering your last letter until the seed collectors had returned from the hills, expecting that they would bring some seeds of Gentians and other plants which I had previously observed, but they are such a lazy apathetic sort of people, that unless a thing comes to hand readily they take no trouble in gathering it. Enclosed are a few seeds of *Acacia Catechu* and of a Barleria. The wood of the Acacia is of a deep brown colour, close-grained, hard, and very heavy. The leaves of the Barleria are held in high repute amongst the native doctors for their efficacy in intermittent fever. They have a bitter taste. The cryptogamic flora of this district is very scanty—about half-a-dozen ferns, the same number of mosses, two Marchantias, one Parmelia, and two Lecideas.

A letter was read from Mr A. Denham, Agri-Horticultural Society's Garden, Madras, in which he states that there are eight acres devoted to the cultivation of the different kinds of cotton, and that he is hybridising them with a native variety, so as to produce plants likely to yield good cotton in India.

Robert Trail, Esq., Aberlady, sent living specimens of *Erica vagans*, var. *multiflora*, gathered by him on a hill near

Ardrishaig, Argyllshire, in October 1861. Mr Trail considers the plants as truly native. He picked several specimens and has cultivated them since.

Mr John Sadler exhibited specimens of *Glyphomitrium Daviesii*, which had been collected by Mr D. Black at Ardtun, Mull, and transmitted to him by Mr Walter Galt, Glasgow.

Mr J. Cross, gardener to Lady Ashburton, sent fresh cuttings of an upright form of Juniper, allied to the Swedish, which grows abundantly on the Downs, near the Grange, Alresford, Hampshire.

Mr A. Robertson, Ballydruin Gardens, sent dried specimens of *Lastrea Fœnisecii*, accompanied with notes of an excursion he had made in the beginning of May to Drumbo Glen, Co. Down.

Mr P. Robertson exhibited a plant of *Thuiopsis borealis* in fruit.

Mr M'Nab placed on the table several interesting alpine plants, including *Fragaria lucida*, from the Himalayas; he also exhibited a flower of *Cereus grandiflorus*, night flowering Cereus, which had been immersed in water for five days, and still remained in an expanded state.

Mr F. B. W. White exhibited specimens of *Asperula taurina*, collected near Corstorphine Hill in a naturalised state.

Mr G. W. R. Hay noticed specimens of *Cardamine pratensis*, producing as many as four flowers on the same axis, separated from each other by extensions of the internodes, so as to appear like a series of coloured verticillate leaves at different heights on the peduncle.

Thursday, 14*th July* 1864.—Professor BALFOUR in the Chair.

The following gentlemen were elected Members of the Society:—

1. *Resident Fellows.*

THOMAS CAIRNS, M.D., F.R.C.S.E.
Rev. R. COLVIN.

2. *Foreign Member.*

Baron de CASTELLO DE PAIVA, M.D., Paris, Professor of Botany to the Polytechnic Academy of Oporto, Lisbon.

The following Donations to the Library were laid on the table:—

Proceedings of the Linnean Society, Vol. VII., No. 28; Vol. VIII., No. 29.—From the Society.

Transactions of the Tyneside Naturalists' Field Club, Vol. VI., Part II.—From the Club.

Transactions and Proceedings of the Dumfriesshire and Galloway Natural History and Antiquarian Society, 1864.—From the Society.

On Literary and Scientific Studies in connection with Medicine, by Professor Balfour.—From the Author.

Proceedings of the Royal Horticultural Society, Vol. IV., Nos. 9, 10.—From the Society.

Memorias da Academia Real das Sciencias de Lisboa, New Series, Tome III., Part 1.—From the Royal Academy of Sciences, Lisbon.

The following Donations to the Museum at the Botanic Garden were noticed:—

From Mr J. B. Davies—Large models of Cruciferous Embryos, prepared by himself.

From Miss Hope—Large drawing of *Lilium giganteum*, executed by Mrs M'Lean, from a plant that flowered at Comely Bank in 1852.

From Mr Gorrie—Fruit of *Rubus spectabilis*.

From Mr Dallas—Fasciated stem of Wallflower.

From Dr Seller—Seed vessels of *Mesembryanthemum Tripolium*.

There has also been added to the museum a table made from the wood of an Araucaria, which was killed by frost in the Botanic Garden in 1860.

The following Donations to the Herbarium were announced:—

From Mr Barnston—Collection of Canadian Plants.

From Mr Naylor—Specimens of *Goodyera repens* and *Primula farinosa* from the neighbourhood of Edinburgh.

From Mr Charles Howie—Specimens of *Bryum Duvalii* from Ben Wyvis.

The following Communications were read:—

1. *Account of the Zambesi District, in South Africa, with a Notice of its Vegetable and other Products.* By Dr John Kirk, late of the Livingstone Expedition.

Introductory to a few remarks on the chief vegetable products of East Tropical Africa, I may point out the leading geographical features of the regions recently explored. The Zambesi is the only river south of the equator of any great size on that coast, and in its hydrographic basin most of our time was spent. At its mouth is a vast alluvial delta extending sixty miles inland with ninety miles of sea face. This is flat or gently undulating land covered with grass vegetation; trees, singly or in clumps, break here and there the monotonous landscape. Such genera as Ficus, Combretum, and Acacia are frequent. Borassus among palms, where it occurs, forms a marked feature, with its tall cylindrical stem bulged in the middle. These plains consist of horizontal beds of clay, sand, and vegetable matter. In the older clay beds are fossil bones of existing species of animals, with indications that at the time of their deposition, a race of men existed whose habits corresponded with those of the negro. The seaboard presents a dark band of forest lining its creeks. Rhizophoras, Barringtonias, Heritiera, Sonneratia, and Pandanus, entwined with Leguminosæ and Convolvulaceæ are here prevalent. The delta land abounds in antelopes and larger carnivora; its rivers and creeks are the haunts of hippopotami and crocodiles, besides containing many species of fish. The Zambesi opens to the ocean by four mouths, of which two only are navigable. In the delta it is a wide stream from one to two miles across; but this at the dry season is full of sandbanks and shallows; to vessels of very light draught, however, it is navigable. Further up on either side of the wide valley are ridges of calcareous conglomerate, representing the Eocene formations of Mozambique. These are the only marine tertiary formations yet found in East Tropical Africa, their absence from the interior being a strong proof of the great antiquity of the continent. Further on we come to sandstone overlying coal. This is the most widely spread rock formation of the

region, and extends far inland. The coast ranges of mountains consist of altered sandstone and a central axis of syenite. At about 300 miles from the coast, navigation is completely stopped by rapids, where the Zambesi passes through a range of mountains, and where for sixty miles it is confined to a rocky bed; but beyond it is again navigable to canoes within forty miles of the Victoria Falls. Above the delta, the Zambesi banks are well wooded, and the finest trees are good for timber—suitable for ornamental work and shipbuilding purposes. Coal is abundant, and the veins conveniently placed; the best, however, are above the rapids, and therefore cut off from the coast. Being unable to take the vessel above the rapids, our original intention of entering in that direction was abandoned, although on foot a rapid march was made along the Zambesi to above the Victoria Falls. Our attention was next directed to the Shire, a tributary stream joining the Zambesi 100 miles from the coast, and therefore easy of access. Of this we could obtain no information among the Portuguese, who did not ascend it, and reported the natives as great robbers and dangerous. The common idea was, that at several days' voyage up it became lost in a marsh among mud and water-weeds. We had before observed the difference in the colour of its water at the confluence, for while the Zambesi was muddy, it remained clear. Contrary to the Portuguese report, it proved a fine stream, narrow at places, but deeper than the Zambesi, and free of the sandbanks which render that river so troublesome. Having passed by water for 100 miles up a rich valley, bounded on either side by mountains, our further progress was stopped by rocks; on foot we followed the river through a rough country for fifty miles, meeting it again smooth and navigable, in a rich open plain 1500 feet above the sea level. To the east, a high table-land divided the upper valley from Lake Shirma, which we next discovered. This lake is about sixty miles in length, and lies between mountains having no known river coming out; it is of little importance. The navigable part of the Shire above the rapids is sixty miles in extent, where it opens to the Nyassa Lake without obstruction. Of this lake it is the out-going river. This inland sea, confounded with others

further north, has long been reported to exist, but had never before been visited by Europeans. On a subsequent occasion, carrying one of the ship's boats over land past the rapids, and launching it on the calm river beyond, we navigated this inland sea for 200 miles due north, when, without reaching the northern end, we were forced to return, native wars having there swept off the population entirely, and rendered it impossible to obtain food for our land party. Believing, as we do, that a few days further would have sufficed to determine the other extremity, to be forced thus to turn was peculiarly annoying. An inland sea, however, had been demonstrated existing in the centre of Africa, separated by only fifty miles' land journey from Europe, for the boat we took up had been built in England, and had reached the lake with that very limited amount of portage only. A large part of the slave and ivory trade of Zanzibar and Mozambique crosses this lake, the caravans being ferried where its width is narrowed to fifteen or twenty miles. On it the Arabs had built a small vessel, which they employed chiefly in the slave trade. Its waters are blue and clear, and off the headlands no bottom was found at 115 fathoms. Mountains everywhere surround it; on the west the slopes of the Central African plateau. At the north they form steep rocky precipices, but further down recede, leaving wide plains and long sandy beaches, or running into the water as bold headlands. The shores are densely peopled, unless at the north, where the Zulus have swept off the natives. Those on the lake obtain most of their food from its waters, fishing with large nets. As usual, in the line of slave trade they are treacherous, yet cowardly. On more than one occasion we were robbed while asleep, and but for our arms would have been attacked. A German traveller, who reached its eastern shore shortly after our first discovery of it, fell a victim in their hands. The present trade with the interior of Africa is carried on with the coast by a long land journey through dangerous and extortionate tribes to the shores of the lake. Prices are so raised, that without the slave trade, which supplies porters, it is very doubtful if the ivory trade would pay. By following the river system now described, all this would be changed, and the interior at once brought within

easy access of the coast. Unfortunately, the Portuguese hold 1000 miles of sea coast, including the entrance of the Zambesi, and while they allow no foreign vessel to enter, carry on no trade themselves. Used as a convict settlement by a country in which capital punishment is unknown, governed by men ill paid, or not paid at all, the natural consequences are the perpetuation of the slave trade among both officers and merchants, and the ruin of the interior by the wars among native tribes to obtain captives. The misery caused by the slave trade is not to be judged of by the slaves who are exported. Probably five are killed for every one who reaches the coast; great districts depopulated; distrust and want of security created. Beyond the immediate vicinity of their few settlements, the Portuguese have no influence, and dare not go above twenty miles inland from the capital. The good laws made by Lisbon statesmen are unknown in the Mozambique. While this state of matters continues, the interior cannot progress, and slaving will never be stopped until the negro becomes of some use in his own country. This he never can be under the existing treaties. For to the sultan of Zanzibar we allow the privilege of slaving within certain waters; to the Portuguese we guarantee the remainder in a less direct but equally successful manner. There is no danger of the negro becoming an extinct race like the American Indian. Europeans may rule the country, but will never colonise it. The climate is a barrier, and the healthy lands of the interior are too far off to give much hope from them for a long time to come. Cotton is the most important of the vegetable products of Africa; it has been long in cultivation among the natives, and it is found in all parts within the tropics. Three distinct kinds are found, which, as far as this region is concerned, are distinct species, although, when studied over a wider field, it becomes difficult to divide them into definite species, the one being then found to pass into the other. The three sorts are, *Gossypium herbaceum*, *G. barbadense*, and *G. peruvianum.* The first yields a short staple adhering firmly to the seed; it is the worst of all, is of a woolly, harsh nature, and seems to be the oldest in cultivation, being found mostly in the regions furthest from the lines of trade. The second, *G. barbadense*, has fine long

staple, and is known by its seeds being free from each other, and the cotton separating readily from the seed. It is grown on the lower Zambesi and south end of the Nyassa Lake. *Gossypium peruvianum* is a large bush or small tree, yields excellent long staple cotton, and has the seeds cohering in masses. It is grown in the centre of the continent and on the Rovuma River; also on the western shores of the Nyassa Lake. In the mountains only are these plants annuals; in all the warm valleys they form perennial shrubs, yielding more than one crop every year. No better seed is required, the quality now cultivated being that most needed by our merchants. With its cultivation the natives are well acquainted. Both the soil and climate of tropical Africa are suited to the crop, for cotton is a sun plant, enduring great drought at the season of ripening its seed. The manufacture in all its stages is carried on by the same individual. Having gathered the crop, it is next picked from the seed, carded by means of a bow, and drawn into thread by hand, a spindle being used to twist it. The loom is a simple arrangement. The threads passed over two bamboos kept apart by four upright sticks, have the cross threads drawn through by a shuttle in length equalling the width of the cloth; each thread driven up by a flat piece of hard wood. Thus, cloths weighing 5lbs. are formed 10 feet long by 5 feet in width; but the time needed for the operation is very great. Universal as is the cotton plant, and excellent as we find its quality, more security is needed before the native will find it advantageous to cultivate it on a large scale. Shut out from civilisation by the exclusive claims of the Portuguese, this never can occur; for while they do not enter into such branches of commerce themselves, they encourage the slave trade, which is the root of all the misery now prevalent. The growth of cotton has this advantage over all others, excepting oil seeds, that it needs little supervision of Europeans; agents to purchase it, if once grown in quantity, and security to the native, being all that is required. Oil seeds rank next in importance; and for ground nut and sesamum, both in great demand, the soil is well adapted. Both are cultivated and thrive well. Other wild seeds yield oils of value, but only second in importance to the

former. Among these are the Trichilia, a handsome tree widely distributed over the continent. Castor-oil is abundant, and small quantities of oil are extracted from the Cucumis and Sterculia. Among fibres, that of the *Lophostylis pallida* is the chief; it furnishes what is made into fishing-nets. Another, the produce of an Ectadium of the Apocynaceous group, is equal in value. These are estimated as superior to flax, and might be had in large quantity. The Sanseviera yields another kind of fibre suitable for rope-making, and is also abundant. Of dyes, the Orchella of the coast is exported in small quantity, and might be procured in much larger, and a yellow dyewood might be had. It is the produce of a species of Cudranea, near to the Maclurea which yields fustic, with which it agrees in physical as well as botanical characters. India-rubber may be gathered from a climbing shrub abundant in the low countries; the plant is near to that yielding the caoutchouc of Madagascar; but nothing has yet been done to develop these branches of industry. The riches of the country are not those of the vegetable kingdom alone. Iron ore, malachite, and coal, are all abundant in the Zambesi hydrographic basin, and will one day become of use to the world. I have brought a few examples illustrative of the arts among the people beyond the influence of Europeans. Their arms show what amount of development they have attained in iron manufacture. The cotton illustrates the making of cloth among them in all its stages. Dr Kirk then exhibited a large assortment of articles of native manufacture, such as weapons, tobacco, cotton, cloths, &c., several of which he presented to the museum. He also exhibited a native loom.

II. *Notice of Botanical Excursions in the neighbourhood of Edinburgh.* By Professor Balfour.

Professor Balfour gave an account of excursions which he had made with pupils this summer to Alloa, Hawick, Tynningham, Newburgh, Dumfries, and Carlaverock Castle, and noticed the chief plants which had been collected.

In the excursion to Alloa and Menstrie Glen, the following are some of the plants picked by the party:—*Corallo-*

rhiza innata, Lorns-hill; *Hymenophyllum Wilsoni*, Menstrie Glen; *Villarsia nymphæoides*, loch at Airthrie; *Corydalis claviculata, Lychnis viscaria, Ornithopus perpusillus, Sedum anglicum, S. reflexum*, Airthrie; *Lactuca virosa*, and *Atropa Belladonna.*

At Hawick, Cavers, and Hassendean, the party was accompanied by Mr J. A. Murray, who acted as guide, and they collected the following plants:—*Aquilegia vulgaris, Corydalis claviculata, Geranium pyrenaicum, Euonymus europæus, Sedum villosum, Sempervivum tectorum, Silaus pratensis, Peucedanum Ostruthium, Lonicera Caprifolium, Valeriana dioica, Carduus heterophyllus, Polemonium cæruleum, Anchusa sempervirens, Melampyrum sylvaticum, Veronica polita, Polygonum Bistorta, Neottia Nidus-avis, Habenaria viridis, Epipactis latifolia.* On Minto Crags—*Asplenium germanicum, A. septentrionale*, and *Lychnis viscaria.*

At Linton and Tynninghame were gathered—*Fumaria micrantha, Sinapis alba, Trifolium hybridum, Potentilla reptans, Sempervivum tectorum, Lonicera Caprifolium, Cynoglossum officinale, Solanum Dulcamara, Antirrhinum majus, Linaria Cymbalaria, Lamium intermedium, Ballota fœtida, Salicornia herbacea, Hippophae rhamnoides, Humulus Lupulus, Listera ovata, Neottia Nidus-avis, Ornithogalum umbellatum, Scirpus maritimus*, and *Ophioglossum vulgatum* near St Baldred's Castle.

At Newburgh, Lindores, Mare's Crag, and Lochmill, were picked—*Ranunculus Flammula, R. aquatilis, R. circinatus, Typha latifolia, Sparganium simplex, S. ramosum, Nuphar lutea, Littorella lacustris, Scirpus lacustris*, and *Glyceria aquatica*, in Lindores Loch. On Mare's Crag—*Potentilla argentea, Dianthus deltoides, Geranium columbinum, G. lucidum, G. sanguineum, Ornithopus perpusillus, Sagina subulata*, and *Malva moschata.* At Denmiln, *Verbascum Lychnitis.* At Lochmill, *Nymphæa alba, Nuphar lutea, Potamogeton crispus, P. natans*, and *P. heterophyllus; Anthemis arvensis, Polygonum viviparum, Epilobium augustifolium*, were also gathered.

In the trip to Dumfries and Carlaverock Castle, by the banks of the Nith, were collected the following:—*Ranunculus sceleratus, Berberis vulgaris, Iberis amara, Sagina*

maritima, *Hypericum dubium*, *Genista tinctoria*, *Carum verticillatum*, *Œnanthe Lachenalii*, *Œ. fistulosa*, not marked as Scotch by Babington; *Haloscias scoticum*, *Senecio erucifolius*, *Centaurea montana*, *Thrincia hirta*, *Jasione montana*, *Ligustrum vulgare*, *Erythræa Centaureum*, *E. littoralis*, *Convolvulus sepium*, *Solanum Dulcamara*, *Mentha sylvestris*, *β velutina*, *Anagallis arvensis*, *A. tenella*, *Samolus Valerandi*, *Allium vineale*, *Juncus maritimus*, *Scirpus maritimus*, *Blysmus rufus*, *Carex vulpina*, *C. remota*, *C. extensa*, *C. distans*, *C. lævigata*, *Lepturus incurvatus*, *β filiformis* (G. Cowan), *Fontinalis antipyretica.*

Professor Balfour also stated that Mr Claudio L. Serra had found abundance of *Goodyera repens* in fir woods at Dalmeny, within six miles of Edinburgh. Mr Naylor exhibited specimens of the plant, which he had collected in company with Mr Serra. This discovery extends the southern limit of the plant considerably.

Mr Howie sent specimens of *Arctostaphylos alpina* from Ben Wyvis.

Mr M'Nab laid on the table flowering branches of *Liriodendron tulipifera* from the Botanic Garden. He also placed on the table a series of British ferns and their varieties in a growing state.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

10*th November* 1864.—Professor BALFOUR, President, in the Chair.

The following Gentleman was elected a Fellow of the Society:—

Mr JOHN S. MUIR, Leith.

The following Donations to the Museum at the Botanic Garden were announced:—

From Dr John Kirk—Leaf Tobacco as used by the Indians of the east African coast; Tobacco cultivated and manufactured by the people of Lake Nyassa; specimens of native Cotton; Bark Cloth; Wood of small Euphorbiaceous tree, called "Mokunite" by the natives; Wood of Azalea sp.; and several other valuable woods from the lake districts of Zambesi.

From Dr Dalzell—Bamboo Seeds, ripened at Bombay.

From a Missionary at Old Calabar—Box of seeds of various kinds of Mucuna and Dolichos, &c.

From Dr Gilchrist and Dr Grierson—Large specimens of *Orobanche elatior*, from the neighbourhood of Dumfries.

From Dr S. C. Mackenzie—Ebony Clogs; model of Chinese Pleasure-Boat made of grass; Birds' Nests made of grass leaves; also various Fruits—all from Calcutta.

From A. Oswald Brodie, Esq.—Staff made from stem of Tree Fern, and Pods of *Entada Pursætha* from Ceylon.

From Robert Menzies, Esq.—Fruit of Nutmeg and Ivory Palm, and Cochineal Insects, from the West Indies.

From Mr James Moir—Double Mushroom.

From Mr John Allison—Specimen of prepared China Grass.

From J. Trevelyan, Esq.—Onion producing buds at the base of the bulb.

From M. G. Wheatley, Esq.—Specimens of two Indian Grasses.

From Professor Balfour—Lepidodendron and Fruit of Quince.

From Professor Christison—Barks of *Ochroma Lagopus*, *Paritium elatum*, *Lagetta lintearia*, and fibres of *Bœhmeria nivea*.

From Master Andrew Francis Balfour—Oak Galls from the neighbourhood of Stubbington, Hants.

From Mr A. C. Christie—Series of Vegetable Bracts mounted on paper.

The following additions to the University Herbarium were noticed:—

From the Committee of the British Columbia Botanical Association—Collection of Dried Specimens from Vancouver's Island, collected by Mr Robert Brown in 1863.

From M. Edelstan Jardin—Parcel of Plants from Cherbourg.

From Old Calabar—Parcel of Dried Plants, principally ferns and lycopods.

From Mr William Milne, Old Calabar, per Mr W. R. M'Nab—Parcel of Dried Plants.

Collection of Plants from Vallée de Pérouse, Piedmont, collected by Dr Edouard Rostan.

Set of British Roses, named and arranged by Mr J. G. Baker, Thirsk.

The President delivered the following Opening Address:—

In entering upon the twenty-ninth session of the Society, I have much pleasure in congratulating the members on its continued prosperity. Uniting, as it does, advanced botanists and junior students of science, our Society has acted most beneficially in promoting the cause of botany and in diffusing a taste for it. The social footing on which we meet has tended in no small degree to render our meetings useful and profitable. The volume of Transactions which is put into your hands this evening shows that good work has been done during the past session. Papers have been read on structural, physiological, systematic, economical, and fossil botany; accounts have been given of botanical excursions and of additions to the flora of Edinburgh; and records have been kept of the state of vegetation in the Botanic Garden. Extracts have also been read from correspondents in various parts of the world, more especially

India, Africa, Canada, Demerara, and Columbia. Profiting by the advice of our former President (Professor Maclagan), some of the junior members have given us abstracts of valuable botanical papers published in foreign journals.

In the department of Structure and Morphology, I call attention to the valuable paper by Dr Alexander Dickson on Diplostemonous Flowers, in which he points out the mode of the development of the staminal whorls in several natural orders, and the development of the carpels in Malvaceæ. The paper is illustrated by characteristic diagrams, and its value has been appreciated by Baillon, who has translated it into French, and printed it in the periodical of which he is editor. Mr Jenner's paper on the Accessory Organ of Selaginella is also one of interest. Papers on Gymnospermous Flowers by Eichler, and on Stomata by Morren, have been translated, and thus brought under the notice of Scotch botanists.

In the department of Physiology, I have to notice a practical paper on the fertilisation of Orchids by Dr Rutherford, who has recently graduated at this University; also papers on the sexual changes in the inflorescence of Zea Mays, and on the sexuality of the higher Cryptogams by Mr John Scott, lately foreman at the Botanic Garden, and who has now gone to India under the auspices of Mr Darwin. His experiments were conducted with great care and ability, and some of his papers have appeared in the Proceedings of the Linnean Society. It is pleasing to find a gardener thus raising himself in science, and acquiring reputation for accuracy of observation and correctness of detail. His papers attracted the notice of Mr Darwin, who was thus led to encourage him in his researches, as well as to advance his prospects in life. The curious researches into the hybridity of plants by Naudin have been given to us in English by Mr Lowe, a zealous botanical student, who is thus following in the footsteps of his uncle, Dr John Lowe, one of our distinguished graduates.

On the subject of Canadian Ferns and Filicoid Plants an able and elaborate paper has been contributed by Dr George Lawson, Professor of Chemistry in Dalhousie College, Halifax, Nova Scotia. The Doctor was long connected with the Society as Assistant-Secretary, and he has never

forgotten us. Compelled by the want of management on the part of the University of Queen's College, Kingston, Canada, to resign his Professorship there, he has, I hope, acquired a better position in Nova Scotia. I am sure that Kingston has lost in him a zealous and indefatigable botanist who was well fitted to convey instruction to students. I hope that his successor, Mr R. Bell, who studied here last summer, may be able to follow in his footsteps.

In the department of Economic Botany we are much indebted to Professor Archer for many important contributions. He has kindly made the resources of the Industrial Museum (which he so worthily superintends) available for our instruction. I hope that ere long we shall see the results of his indefatigable labours in the splendid museum which is now hastening to completion. The cultivation of tea, cinchona, and cotton is attracting much attention now-a-days. Our Indian possessions are well fitted for the production of these important articles ; and the reports of Dr Thomas Anderson, Mr Wm. Jameson, and Dr Alex. Hunter (all former Edinburgh students) have been most satisfactory. I shall have occasion during the present session to allude still further to the subject. In the meantime, I may state that I have sent to India from our Botanic Garden within the last few years, chiefly for the cultivation of cinchona, tea, and cotton, five or six gardeners brought up under the direction of Mr M'Nab, the able superintendent of the Botanic Garden. These men are doing credit to our Garden as a school of horticulture as well as of botany. We have had the pleasure of welcoming back our friend Dr Kirk, who accompanied Livingstone in his explorations, and who has given us an excellent account of the products of the Zambesi and of Southern Africa. He is one of our graduates who has done credit to our school. As regards the localities of plants we may record the additions made to our Flora in the finding of *Goodyera repens* at Dalmeny by Mr Claudio L. Serra. It is remarkable that a Portuguese student should thus discover a new plant in a district which has been so well examined by Scotch botanists. A similar remark may be made as to the discovery of *Asplenium viride* near Cramond, by Mr Carruthers, of which a notice will be read this evening. In place of extirpating plants, as some of our Southern

friends state, we seem to be adding to our flora year after year. This year two new localities have been found for Corallorrhiza, one by Dr Dickson and the other by Mr Sandilands. I must not omit to mention that two ladies, Mrs and Miss M'Inroy, have contributed notices relative to the mosses of Perthshire.

Fossil Botany has also occupied a share of our attention. Saporta's paper on the Tertiary Flora of France has been translated. On the 26th of March a special meeting of the Society was held, at which we had the honour to receive H.R.H. Prince Alfred as an honorary member of the Society, and on that occasion I was privileged to give a *resumé* of what had been done in the way of advancing our knowledge of fossil plants, my remarks being illustrated by a series of excellent drawings from the pencils of Dr Greville and of Mr Neil Stewart.

During the past year ten ordinary members have been added to our list, and one foreign member. The total number of ordinary members is 335; of honorary members (British, 4; foreign, 19), 23; of foreign members, 81; of life members (ladies), 11; associates, 25; making a total of 475. I have to record the loss of five members by death during the past year,—viz., William Brown, paymaster, R.N.; Rev. Dr John Anderson, Newburgh; Adam Gib Ellis, W.S.; Dr Robert Dundas Thomson; Professor Treviranus; and Mr James Stratton.

The first of these, William Brown, joined the Society on 9th November 1843, and continued to take a warm interest in its proceedings. He was born about 1786, at Chirnside, in Berwickshire, and died at 24 Blacket Place, Newington, on 7th May 1864. He entered the royal navy early in this century. He was first appointed to the Owen Glendower, then on the stocks. In the meantime, he served for a year in the Texel, 74, then guardship in Leith Roads. In the Owen Glendower he was three years in the East Indies. He afterwards served in the Chinese seas. Being paymaster of his ship, he was sent, with the first lieutenant, on a mission to the Chinese governor. They were taken for spies, and kept in prison for three months, and were finally released under threats of a bombardment of the town. Mr Brown was nearly poisoned under pretence of a parting

cup. His brother officer got him conveyed with difficulty in an insensible state to the boat waiting for them. After the peace of 1814 he served on the South American station, then at the Cape, and lastly in the Mediterranean, under Admiral Park. He served in the Niger, the Cornwallis, the Pique, and the Queen, and was a great favourite everywhere. About fifteen years ago, Mr Brown retired in bad health to Edinburgh, where he has since resided. In 1862 he met with a severe accident, being thrown down and much hurt by a cart at Canonmills Bridge. He was attended by his friend and medical adviser, Dr Seller. From the accident he recovered remarkably. In autumn 1863 he had a threatening of an apoplectic kind, which, however, passed away, leaving him for some months in a weakened state. In the spring of 1864 he met with a second accident, from which he was recovering when he had another paralytic seizure. Under this he gradually sank, retaining his intelligence, however, to the last. He was a genial and kind-hearted man, and he took an interest in natural science, from the prosecution of which he derived much pleasure during his various wanderings over the world.

The Rev. John Anderson, D.D., minister of Newburgh, was one of the early members of the Wernerian Society, and when that Society was broken up, he became a member of the Botanical Society on 9th December 1858. He was born at Newburgh on 30th October 1796. His father was for forty-two years one of the magistrates of the burgh. His uncle, the Rev. Dr Stuart, had been minister of Newburgh for nearly forty years. After prosecuting his early studies at the parish school, Mr Anderson entered the University of St Andrews, where he studied for seven sessions. He was a diligent and attentive student, and distinguished himself in his classes. He afterwards prosecuted his theological studies in Edinburgh, and was licensed as a preacher by the Presbytery of Cupar. He became minister of Dunbarney in 1821, and continued there till 1833, when he was transferred to Newburgh. Soon afterwards the University of St Andrews conferred on him the degree of D.D. On August 11, 1838, he became a member of the Wernerian Society. He devoted his leisure hours to the prosecuting of literature

and science, and he seems to have been much encouraged in his scientific labours by the Rev. Dr Fleming of Flisk. Geology occupied a prominent share of his attention. He did much to illustrate the geology of Fifeshire, and for an essay on this subject he gained the gold medal of the Highland and Agricultural Society in 1838. He published a work on the course of creation. He wrote a treatise on Scottish Geology, in a work on the History of Scotland, which was published in Glasgow; and in 1859 he gave forth an illustrated work on Dura Den, containing an account of the fossil fishes of that locality. He contributed several articles on geological subjects to various periodicals, and at the meeting of the British Association at Aberdeen he strongly opposed the views of Lyell and others relative to the remains of man. Some years ago he had a paralytic attack, from which he never recovered completely. He visited the southern part of France with the view of recruiting his strength, and he died at Nice on 16th March 1864, in the sixty-eighth year of his age.

Adam Gib Ellis, W.S., was another of the members of the Wernerian Society whose names were added to our list on 9th December 1858. He was born at Edinburgh on the 25th March 1794. He was educated at the High School and the University of Edinburgh, and passed writer to the Signet in 1817. He entered the Wernerian Society on 1st December 1821. He was elected treasurer in 1825, and he continued to hold that office until the Society was dissolved. On the death of Mr Christopher Douglas, he was chosen Fiscal of the Society of Writers to the Signet. He was also a member of the Royal Company of Archers. The Rev. Dr Thomson, in a letter to me, says—"Mr Ellis was an enthusiastic antiquarian, and has left behind him some rare and valuable articles of antiquity, which should find their way to the Museum. Among others, Cardinal Beaton's chair, and some fine specimens of tapestry, said to have been the work of the three Marys. He was a man of singular urbanity and good feeling. Up to the period of his infirm health he was an active elder in the Broughton Place U.P. Church. He visited in his district for many hours every week, and took a conscientious oversight of the people committed to his charge. His singularly honour-

able and gentlemanly spirit made him a sort of medium of intercourse between the different religious denominations, and he helped to smooth down in more quarters than one sectarian asperities and jealousies." He acted for eighteen years as the Secretary of the Scottish division of the Evangelical Alliance. He died on 13th May 1864.

Robert Dundas Thomson was second son of the Rev. James Thomson, D.D., minister of Eccles, Berwickshire. He was born there on 21st September 1810. His early studies were prosecuted at the grammar school of Dunse, whence he proceeded to the University of Edinburgh. He went through the curriculum of arts, and then commenced the study of medicine. He subsequently prosecuted chemistry at Glasgow under his uncle, Dr Thomas Thomson, the Professor of that science. He graduated at Glasgow in 1831, and after a voyage to India and China in one of the Company's ships, he settled in London as a physician. He lectured on chemistry in the Blenheim Street School of Medicine, and he assisted Dr Farr in editing the "British Annals of Medicine." He subsequently undertook the publication of the "Records of Science." The advancing age of his uncle in Glasgow called for an assistant, and Dr R. D. Thomson undertook the duties of the office. He conducted the Chemistry Class in the University of Glasgow for many years with great success, and he acquired the confidence and esteem of the manufacturing body. In 1852 he was an unsuccessful candidate for the Chair of Chemistry, which then became vacant. He returned to London, and became Lecturer on Chemistry in St Thomas' Hospital. In 1855 he was elected medical officer of health for the parish of St Marylebone, an office for which he was well fitted by his chemical, medical, and local knowledge. He did much good in originating and promoting sanitary measures in connection with water supply, drainage, food, and hygiene. Under the pressure of his laborious duties his health gave way, and notwithstanding all the care and attention of kind friends, he gradually sank, and died on 17th August 1864. He was an able chemist. His works, entitled "School Chemistry" and "Cyclopædia of Chemistry," are of standard value. He devoted special attention to chemistry in a physiological point of view, and contributed many papers

of high value on sanitary questions, such as the adulteration of drugs, the chemistry of digestion and of cholera, the nutritive value of different kinds of food for cattle, and the supply of water. He was a zealous meteorologist, and at the time of his death he was President of the Meteorological Society of London. He became a non-resident Fellow of the Botanical Society on 9th June 1836. He was thus among the early founders of the Society. In 1850 he was elected a Fellow of the Royal Society of Edinburgh, and on 1st June 1854 he became an F.R.S. London. He was a Fellow of the Chemical and Medico-Chirurgical Societies of London, and of the Berwickshire Naturalists' Club, which he entered on 22d September 1831.

Ludovic Christian Treviranus was born on the 10th September 1779. He was the third son of his father, who had come as a boy to Bremen. The family is said to have belonged to Trier. His mother was Catherine Margarethe Tallau of Bremen. After having attended the schools of his native town, he devoted himself to the study of medicine, first at Göttingen and afterwards at Jena, where he received his degree of doctor of medicine. Since that time, as he himself said sixty years later (23d October 1861), he took zealous care *ne vita transeat ceu fumus in auras abit, vel in fluctus spuma.* Engaged in medical practice in his native town, he was in 1807 appointed teacher in the Lyceum there. In 1812 he was called to Rostock as Professor of Botany, as successor to Link, who had gone to Breslau. Afterwards he again succeeded Link at Breslau, when the latter was appointed to fill the place of Willdenow at Berlin, which had long been vacant. In 1830, however, when private circumstances rendered it desirable for the Professor of Botany in Bonn (C. G. Nees von Esenbeck), to resign his appointment in that university, Treviranus resolved to exchange the post he had up till that time held, and with which he had been much pleased, for that in Bonn, where he remained until his death. He superintended the Botanical Garden there, but he met with such interruption to his work in connection with the garden that he resigned the charge of it.

He was active in the prosecution of science, as is testified by the number of different works which he published, either

as independent volumes, or as contributions to the transactions of the academies, societies, or associations of which he was a member. He also wrote papers for a periodical which was conducted by him along with his elder brother and Tiedemann. His studies were especially directed to the vital relations in living plants, and to the precise separation of plant-species. Very familiar with botanical literature, and following it in all directions, he took pains with his library, which he continually strove to increase, as well for the enriching of his own knowledge as for the critical elucidation of difficulties. His numerous works testify sufficiently to his extensive learning and comprehensive knowledge.

Willdenow bestowed his name upon a genus of Gesneraceæ, which, however, has been restored to the genus Achimenes. Professor Treviranus was elected a Foreign Honorary Fellow of the Botanical Society on 9th February 1837.

James Stratton was an Associate of the Society. He was born in the village of Spittalfield, in Perthshire, in 1819, and served his apprenticeship in the garden of Sir J. M. Mackenzie of Delvine, where he remained for three and a half years. He was afterwards for six months in the nursery of Messrs Dickson and Turnbull at Perth, one and a half year in Murie garden near Errol, six months in the Museum of Messrs Lawson, six months at Invermay with Major Belshes, and nine years in the Edinburgh Botanic Garden. He joined in some of the botanical excursions to the Highlands. He showed himself to be a zealous and indefatigable collector, and possessed a good knowledge of plants and of their mode of cultivation. He was appointed superintendent of the Botanic Garden at Cambridge, a situation which he filled for fourteen years; and he died there on 18th August 1864.

Edinburgh has long been famous for its school of botany; and I believe that our Society was the first of the kind instituted in Great Britain. In 1670 a botanic garden was established in Edinburgh under the name of the Physic Garden,—a name which is still retained in the locality where it existed. In 1676 a professorship of botany was instituted, and James Sutherland was appointed professor.

At that time the collection consisted chiefly of medicinal plants, and the professor, besides his lectures, gave demonstrations on the plants in the garden. In a document in the possession of the Royal College of Surgeons, Sutherland appeals for the support of the garden, and intimates his willingness to give instruction in medicinal plants to the apprentices of Fellows of the College, and to others who are studying the articles of the materia medica derived from the vegetable kingdom.

In the Surgeons' Records, 11th June 1695, the following entry is made:—

"A petition was presented by Mr James Sutherland, Professor of Botany within this cittie, in which he states that the botanical garden is in excellent order, and the plants classed into various tribes, as they nearest resemble each other in flower and seed, so that nothing is wanting in that garden to make the study of botany both pleasant and easie, all being chiefly intended for the instruction of apprentices and such others, and therefore desyred the calling would take the said garden into their protection (seeing what was done was for the great advantage both of the masters and of all those under their charge), and by their act to ordain all the apprentices and servants, and others that have libertie of their shops, immediately at entry to their service, to pay a guinee or twenty-three shillings sterling to him, for which the petitioner obliges him to owne all the masters of the said Incorporation as his patrons, and to attend them in the garden, and demonstrate the plants whensoever they have inclination, and besides wait upon them at a solemn publick herborizing in the feilds four severall times every year, and to teach their apprentices and servants, and all concerned in their shops, who have payed their money, at such hours every day as the masters shall think fitt to appoint, from their first entry to their service as long as the petitioner shall have the said botanick garden, &c."

The petition, on the above conditions, was granted.

In his catalogue of plants of the Edinburgh Garden, Sutherland enumerates many species used in medicine. The science of botany was then in its infancy, and little was known of structure and physiology. The student had chiefly

to study the external form of plants, and to know their uses in medicine. One of the Professors who succeeded Sutherland (George Preston) exercised his calling also as a druggist in Edinburgh. Dr John Hope gave an impetus to the study of botany when he succeeded to the chair. He was a supporter of the Linnean system, and one of his pupils, Sir James Edward Smith, afterwards became a zealous advocate of that system, and published many works in which this method of arrangement was followed. Dr Hope appears to have encouraged practical botany by offering a prize for the best herbarium of plants gathered within a limited district round Edinburgh; and in 1782 the gold medal was gained by Sir J. E. Smith. Little, however, appears to have been done in the way of field-work and of excursions to different parts of the country with pupils, until Dr Robert Graham became Professor of Botany here. During a considerable part of his incumbency he made two or three excursions during the summer with students round Edinburgh, and thus tended to promote a taste for practical botany. In 1821 he made his first excursion to the Highlands, and in it he was accompanied by Mr M'Nab. He was joined also by Mr Mylne and Mr Drummond of Forfar. In 1825 he took an excursion to Sutherlandshire with a former pupil, Dr John Home, son of Dr James Home, Professor of the Practice of Physic. This seems to have led to extended excursions with pupils of the botanical class. In 1827 Dr Graham organised his first autumn trip with the class. What he had seen in Sutherlandshire encouraged him to visit that county again, and he accordingly announced to his class that he intended to make that county the scene of his herborization in the month of August. Being a pupil of the class that year, I put my name down. The party consisted of Dr Graham; his brother, Captain Graham; Mr M'Nab, the superintendent of the Garden; Mr Murray, an Aberdeen student of botany (afterwards author of a Northern Flora); Mr Samson, son of a nurseryman at Kilmarnock; Mr M'Lelland from Galloway; Miguel Marie Lisboa, a Portuguese student from Rio Janeiro; and myself. We started by steamboat on Friday, 3d August, for Aberdeen and Cromarty, where we landed. Then we proceeded by Tain and Bonar-Bridge to Lairg, Loch Shin, Ben More,

Assynt, Handa, Scourie, Laxford, Riconich, Foinivan, Durness, Cape Wrath, Eriboll, Ben Hope, Tongue, Kildonan, Clyne, and Bróra. The excursion lasted for about five weeks. In these days there were no roads in the wild districts of Sutherland, such as Eddrachillis. Our baggage was conveyed on horses, and we had to make the best of our way through trackless moors. Moreover our accommodation was anything but good. Small sheilings often were all our shelter, and we had to sleep on mud floors or on wooden chairs or tables. We gathered the usual alpine plants, and among others *Arctostaphylos alpina*, *Luzula arcuata*, *Arabis petræa*, *Sibbaldia procumbens;* and on Ben Hope we picked *Polypodium alpestre*, which we supposed at that time to be a form of *Asplenium Filix-fœmina.* Besides these I also gathered at Durness *Eriophorum alpinum.* At the time I supposed it to be *Scirpus cæspitosus*, and marked it as such, and it is only recently that I have noticed the error. It is worth while looking for this plant, as this is probably the only locality for it in Britain since the draining of the Loch of Restenet.

In 1828 the autumn class excursion was arranged for Ben Lawers. The party consisted of Dr Graham, Captain Graham, Mr M'Nab, and Messrs Edmeston, Young, Shapter, Omond, Cumming, Bain, North, and myself. We visited Ben Lawers and the mountains near it, including Craig Chailleach, Ben y Cruben, &c. We gathered all the rare alpine plants of the district, including *Saxifraga cernua*, *Alsine rubella*, *Myosotis alpestris*, *Draba rupestris*, and *Woodsia hyberborea.* One station for the last-mentioned plant is noticed as Craig na Vochan.

In 1829 Dr Graham had no regular excursion with his class, but some of his pupils visited Blairgowrie and Craighall, where they collected *Convallaria verticillata*, *Neottia nidus-avis*, and then proceeded to Clova.

In 1830 an excursion was made to the Braemar district. The party consisted of twelve. They ascended Ben na Bourd, Ben na Muc Dhui, and Lochnagar, and visited Glen Callater and Glen Candlich. Subsequently they walked to Glen Dole and Clova. The excursion occupied eleven days. On this occasion *Carex Vahlii* was added to the British flora, having been gathered by Dr Greville and myself separately

in Glen Candlich. *Polytrichum septentrionale* was found in profusion in fructification. *Saxifraga cæspitosa* was also gathered by Mr M'Nab on Ben na Bourd, being the first time that the plant had been picked in Scotland.

In 1831 Clova and Braemar were again visited from 29th July till 10th August. *Astragalus alpinus* was added to the British flora, having been discovered by Mr Brand on high cliffs at the upper part of Glen Dole. Dr Martin Barry also found *Saxifraga cæspitosa* on Ben Avon, on the west side of Slock More, chiefly among moss on disjointed portions of rock, on a sheltered spot half-way up the cliff. John Mackenzie, gardener at Invercauld, accompanied Dr Barry as guide. This Saxifrage has not been found since that time.

In 1832 the botanical class party was again on the mountains of Clova, and the excursion extended to Glen Isla and Glen Callater. *Lychnis alpina* was gathered this year on Little Gilrannoch, where it had been seen by Sir John Ogilvy on 30th July. *Mulgedium alpinum* was seen in several stations in Glen Dole and in Canlochan. *Thlaspi alpestre* was found for the first time in Scotland in Canlochan. *Malaxis paludosa*, *Carex rariflora*, *Carex pulla*, and *C. aquatilis* were seen in abundance in many places. *Carex Vahlii* was gathered in Glen Fee, and *C. Grahami* was also picked in that glen by Dr Wight. *Ajuga alpina* is recorded as having been collected. *Gentiana nivalis* was seen in profusion in Canlochan. In speaking of the last-mentioned plant Dr Graham remarks :—" The sparkling of this most rare and lovely little gem among the scanty mountain herbage, cured me of hunger and thirst, and made me forget that I was gathering it at the risk of my neck, for which I have in general on such occasions a regard at least equal to its value."

This autumn Mr Hewett Cottrell Watson made observations on the height at which Scottish alpine plants grow, and commenced those observations which resulted in his able prize essay given in to the Professor of Botany, on the geographical distribution of British plants, and which ultimately led to his valuable publications, which are standard works on the botanical geography of Britain.

In 1833 Sutherlandshire was again visited with a large party, which proceeded by Invergordon, Bonar-Bridge,

Oikel, Inchnadamff, Kylestrome, Scourie, Badnanbeg, Laxford, Riconich, Durness, Eriboll, Cashildhu, Tongue, Farr, Strathnaver, Altnaharrow, Lairg, Golspie, and Tain. The following were among the interesting plants recorded:— *Alsine rubella*, *Draba rupestris*, on Ben Hope; *Carex filiformis* at Laxford and Riconich; *Fucus Mackaii* near Kylestrome.

In 1835 an excursion was made to the Mull of Galloway. *Statice spathulata*, *Inula crithmoides*, *Crithmum maritimum*, *Raphanus maritimus*, *Orchis pyramidalis*, *Convolvulus Soldanella*, and other rare Scottish plants, were collected. *Ononis reclinata* was gathered for the first time in Britain, in great profusion on a cliff to the west of the Mull of Galloway.

In 1836 Galloway was again the scene of the botanical labours of the class. The excursion was extended to Glenluce, Whithorn, and Garlieston. Among other plants may be noticed *Scutellaria minor*, *Erodium moschatum* and *maritimum*, near Port-William, *Artemisia maritima* near Whithorn, *Statice bahusiensis* at Garlieston.

In 1837 Dr Greville, Mr Brand, and myself went to Clova and Braemar for the purpose of procuring alpine plants for distribution by the Botanical Society. We dried in the course of three weeks upwards of 15,000 specimens.

In 1838 Ireland was the point to which we directed our attention. A party, consisting of Dr Graham, Mr M'Nab, Messrs J. D. Hooker, Markham, Lewis, Ashby, Sibbald, and myself, sailed for Dublin, where we were joined by Mr J. T. Mackay, Mr Simon Foot, and two other Irish botanists. We botanised in the neighbourhood of Dublin, and then proceeded to Balinasloe, Galway, Oughterard and the Connemara district, Clifden, the Killeries, Maam, &c. All the interesting Galway plants were gathered by us, including *Erica mediterranea*, *E. Mackaiana*, *Dabeocia polifolia*, *Eriocaulon septangulare*, *Saxifraga umbrosa*, *Rhynchospora fusca*, &c.

In 1839 the districts of Callander, Loch Lubnaig, Killin, and Ben Lawers were examined botanically, the excursion lasting from 2d to 10th August.

In 1840 Clova and Glen Isla were the points of rendezvous.

In 1841 Dr Graham was unable to join the autumn trip,

and he requested me to conduct it for him. It extended from the 2d to the 27th August. The party consisted of Mr M'Nab, Mr Babington, Messrs Hore, Blamey, Hanson, James, Mactier, and myself. We proceeded first to Skye, visiting the Cuillin hills, Sligachan, and Dunvegan; then we proceeded to South Uist, North Uist, Harris, the Shiant Isles, Lewis, as far as Stornoway, and the Butt; and we returned by Poolewe, Loch Maree, Dingwall, Ben Wyvis, and Inverness. A full report of the trip was printed in the Transactions of the Society, drawn up by myself and Mr Babington.

In 1842 Dr Graham's excursion was to Ross-shire and Ben Nevis, while I conducted parties to Arran, Loch-lomond, and Argyleshire.

In 1843 Dr Graham extended his botanical researches to North Wales, the south of England, and Jersey, while I visited Ayrshire, the Mull of Galloway, Wigtonshire, and Dumfriesshire.

In 1844 my botanical party visited Loch Lomond and Ben Lawers from 30th July to August 6. Again from 16th to 24th August a botanical party went to Campbelton, the Mull of Cantyre, and the island of Islay. The account of the trip was published in the Proceedings of the Glasgow Philosophical Society.

In 1845 three days were spent in Arran from 10th to 13th July; while in August a party went to Loch Lomond, Ben Voirlich, Glencoe, Ballahulish, Fort-William, and Ben Nevis.

In 1846 the district of Loch Lomond, as well as Clova and Braemar, were visited. *Luzula arcuata* was found in Lochnagar.

In 1847 a party of thirty-two went to Arran; and later in the season a trip was made to Braemar, Glen Isla, Glen Tilt, and Ben Lawers. On this occasion the scene took place in Glen Tilt which has been recorded in verse by Professor Maclagan. In this excursion many interesting plants were gathered. On Little Craigindal *Astragalus alpinus* was found in profusion; *Carex leporina* was gathered in Cairn Toul; *Sagina nivalis* on Ben Lawers; and *Mulgedium alpinum* on Lochnagar. The party slept in hammocks on the summit of Ben na Muc Dhui.

The following plants are recorded as having been gathered on Little Craigindal on 12th August :—

Little Craigindal, 12*th August* 1847.

Astragalus alpinus.
Potentilla alpestris.
Carex capillaris.
Thalictrum alpinun.
Luzula spicata.
Carex rupestris.
Dryas octopetala.
Silene acaulis.
Saussurea alpina.
Pyrola secunda.
Pyrola media.
Saxifraga oppositifolia.
Saxifraga hypnoides.
Tofieldia palustris.
Polygonum viviparum.
Juncus triglumis.
Carex rigida.
Alchemilla alpina.
Habenaria viridis.
Carex vaginata.
Botrychium Lunaria.
Geranium sylvaticum.
Juncus trifidus.
Saxifraga aizoides.
Poa alpina.
Carex præcox.
Galium boreale.
Statice Armeria.
Azalea procumbens.
Gentiana campestris.
Arbutus Uva-ursi.
Cornus suecica.
Epilobium alpinum.
Rubus Chamæmorus.
Saxifraga stellaris.
Empetrum nigrum.
Drosera anglica.
Erigeron alpinus.
Calluna vulgaris.
Lycopodium annotinum.
Lycopodium alpinum.
Lycopodium Selago.
Lycopodium selaginoides.
Trientalis europæa.
Vaccinium Myrtillus.
Vaccinium Vitis-Idæa.

The following on the summit of Ben na Muc Dhui on 13th August :—

Summit of Ben na Muc Dhui, 13*th August* 1847.

Carex rigida.
Luzula spicata.
Luzula arcuata.
Silene acaulis.
Aira alpina *var.* vivipara.
Juncus trifidus.
Salix herbacea.

The following on the summit of Cairngorm on 13th August :—

Summit of Cairngorm, 13*th August* 1847.

Luzula arcuata.
Salix herbacea.
Carex rigida.
Festuca vivipara.
Trichostomum lanuginosum.
Silene acaulis.
Lycopodium Selago.
Juncus trifidus.
Empetrum nigrum.
Luzula spicata.

In 1848 the period between 24th and 29th July was occupied in a trip to Ben Lawers, the number of the party being fourteen.

In 1849 a party of nine went to Braemar from 3d to 18th August.

In 1850 a party of thirty went to Clova from 18th to 20th July, and in August Arran was visited.

In 1851 a party of nineteen went to Loch Lomond from 24th to 26th July, and gathered alpine plants on Ben Voirlich and Ben Lomond.

In 1852 a party of forty-one went to Arran from 22d to 24th July, and botanised at Lamlash, Brodick, Goatfell, Glen Sannox and Corrie. Again, from August 6th to 28th, a party of eight went to Ireland, visiting Dublin, Howth, Malahide, Bray, Powerscourt, under the guidance of Dr Mackay, Professor Allman, and Mr Robert Ball. The party then proceeded to Cork, Bandon, Bantry, Glengariff, Kenmare, Muckross, Gap of Dunlo, Killarney Lakes, Macgillicuddy's Reeks, Mangerton, Tralee, Dingle, Bandon Mountain, Limerick, Lough Derg, Ballinasloe, Athlone, Galway, Island of Arran, Roundstone, Clifden, Maam, Oughterard, and finally, Belfast.

In July 1853 a party of forty-five went to the Cumberland Lakes, visiting Windermere, Ambleside, Rydal, Grasmere, Wythburn, Helvellyn, Patterdale, Ulleswater, and Penrith; while from the 2d to 11th August the Grampians at Clova were examined.

In July 1854 a party of two hundred visited Inchkeith and Inchcolm, under the direction of Professor Edward Forbes, Colonel James (now Sir Henry James), and myself. Botany, geology, and zoology were combined.

In the same year, from 26th to 29th July, a party of forty-five, under the guidance of Professor Forbes and myself, went to the upper part of Loch Lomond, and examined Ben Duchray, Ben Loy, and Ben Voirlich. Again, from 8th to 18th August, fifteen went to Ballater, Balmoral, Braemar, Lochnagar, Craigindal, Glen Callater, Canlochan, Ben na Muc Dhui, and Cairngorm, where we slept under the Shelter Stone. This stone was measured by Mr Birdwood as follows:—40 feet long on an average; 20 feet broad; 16–18 feet high; contents estimated at about 500

cubic yards, equal to about 1000 tons. The party returned by Glen Tilt, Killiecrankie, and Dunkeld.

In 1855, on 20th and 21st July, Eyemouth and St Abb's Head were visited by a party of twenty-three; and from 3d to 11th August a party of twenty visited the mountains near Killin. On this occasion *Cystopteris montana* was found in considerable quantity both on Ben Lawers and Meal Uachdar.

In July 1856, fifty-eight pupils went to Arran, under the direction of Professor Allman and myself, combining botany and zoology on this excursion. On 18th and 19th July a party of thirty-three went to Moffat, the Grey Mare's Tail, Loch Skene, Whitecoom, and Hartfell. *Woodsia ilvensis* was gathered.

On 17th and 18th July 1857, twenty pupils went to Coldstream, the Tweed, Norham, and Berwick ; while from 23d to 25th July, Loch Lomond was visited, and in August the Island of Arran. A complete circuit was made of the Island.

1858. From 7th August to 1st September, a party of twenty-four visited Switzerland, proceeding by Rotterdam and the Rhine to Frankfort, Heidelberg, Berne, Thun, Grimsel, Zermatt, and Geneva. The details of the trip were printed in the Society's Transactions.

1859. A party of thirteen went to Clova.

1860. Glen Lyon, Breadalbane Hills, Ben Lawers, and Schiehallion were examined.

1861. Excursions were made to the Lomonds, Perth, St Andrews, and Bridge of Allan. With a limited party I visited Switzerland and Italy. Botanised on Mont Blanc, the Jardin, &c.

1862. No extended trip was taken. Ben Ledi was visited.

1863. Party of nineteen went to Clova and the Grampians. The hills near Callander and Balquhidder, Ben Voirlich (Perthshire), and Ben Lawers were also visited. *Draba rupestris* was gathered on Binnain.

August 1864. Party of six went to Loch Lomond, Ben Voirlich, the Cobbler, Benima, Ben More, and Binnain. *Sagina nivalis* was gathered on Binnain, and subsequently in large quantity on Ben Lawers. *Phyllodoce cærulea* was also picked on the Sow of Athole.

It will thus be seen that a great deal has been done in the Edinburgh School in the way of promoting practical botany; and hence it is that many of our students have acquired a knowledge of the science which has fitted them for appointments in various parts of the world. It was the zeal of students that first instituted our Botanical Society, and it is to their instrumentality that it owes its success in no small degree. Our meetings in the Garden during summer keep up an interest in practical botany; and now that we have got one of the finest rooms in the kingdom for our Herbarium, I hope that the plants will be rendered still more available for study. In arranging the Herbarium, I hope to be able to have separate cases for British plants and for medicinal and poisonous plants, as well as for the plants of Scripture, and to illustrate to a certain extent the Floras of India, Australia, North and South America, Africa, and Europe. Much is now being done in the investigation of the geographical distribution of plants. The Flora of India, which has been partially described by Wight and Arnott, is now to be published by Drs Thomson and Hooker, under the auspices of Government. The Flora of Australia is also partially published by Bentham and Dr Mueller, and that of New Zealand by Dr Hooker. Grisebach has given us an excellent Flora of the West Indian Islands; Thwaites, a Flora of Ceylon; Bentham, a Flora of Hong-Kong; Harvey, a Flora of the Cape; and we may hope ere long, by the labours of Mann, Oliver, and Kirk, to have an African Flora. For our colonial Floras we are indebted to the efforts of Sir W. J. Hooker, who has, by means of persevering exertions and powerful arguments, at length induced our Government (always slow to encourage science) to give its aid.

Another publication which promises to be of immense value is the description of all the known genera of plants by Hooker and Bentham. This will take the place of Endlicher's work, which, since the death of the author, has been allowed to fall behind the state of science.

As regards Vegetable Physiology, we may remark that a subject which has attracted great attention of late years is the effect of the light and heat of the sun on plants. The view is generally adopted that the solar heat and light are taken up by plants and used by them in the development

of their tissues. The special attribute of the vegetable germ is its power of utilising after its own particular fashion the heat which it receives, and of applying it as a constructive power to the building up of its fabric, after its characteristic type. "The final purpose of the vital activity of the plant, in so far as the individual is concerned, is to produce dense ligneous permanent tissue, by the successional development, decay, and renewal of the soft active and transitory collective tissue; and the change of a portion of the material of the latter into binary compounds, as shown by the large exhalation of CO_2, which takes place, according to Carpenter, from the leaves in the latter part of the season, comes to the aid of internal heat in supplying the force by which another portion of these materials is raised to the condition of organised tissue. The vital activity of the plant is also manifested in reproduction, or the formation of germs of new individuals. Hence, while a higher temperature is usually required for the development of the flower, and the maturation of the seed, than that which suffices to sustain the ordinary processes of vegetation, a special provision appears to be made in some instances for the evolution of force in the sexual apparatus itself, by the retrograde metamorphoses of a portion of the organic compounds prepared by the previous nutritive operations. This is said to be the nearest approach presented in the vegetable organism to that which we shall find to be an ordinary mode of activity in the animal." That there is a great expenditure of vital force in the generative act, may be shown by the fact that, while blossoms soon wither and die after the ovules are fertilised, they may be kept long fresh if fertilisation is prevented.

The decay going on in plants restores to the inorganic world, in the form of CO_2, HO, and NH_3, a part of the materials drawn from it in the act of vegetation. In this process a certain amount of heat is given forth, just as in ordinary combustion. Thus, plants restore to the inorganic world the materials and the forces at the expense of which their fabric was formed. Sometimes this restoration takes place in the form of motion, as seen in the zoospores and other moving germs of Algæ, &c. We cannot, however, go the length of some who hint that the phenomenon of

intellect and will may by natural evolution be developed from incandescent matter. Such speculations are of a most dangerous tendency, and land us in all the errors of materialism.

I shall not attempt to enter on a review of all that has been done in botany during last year. I have generally endeavoured during the session to give from time to time *resumés* of what is being done in different departments, and that plan I hope still to continue.

No science is better fitted to call forth the powers of observation in young men, and to give them habits of diagnosis and powers of description, with accuracy of definition. Hence its value to all classes of the community, and especially to those who are about to enter upon the study of medicine. I say, about to enter on that study, because I believe that the study of the natural sciences ought to precede purely professional study. Until that plan is generally adopted, we cannot expect that proficiency will be attained. The institution of degrees in science is calculated to encourage the study of the sciences, and all we want in our universities are fellowships in natural science to induce young men to devote their time and attention to such pursuits. We hope that the example shown by men of fortune of late in establishing fellowships in arts will be followed by others in the direction of science.*

All our researches in science, while they tend to foster a spirit of genial friendship, are at the same time well fitted to enlarge our views of the wondrous plan of creation, and, when prosecuted in the right way, to lead us to contemplate the infinite wisdom, power, and goodness of Him who is not only the Lord of creation, but the God of all grace, and who, in His works as well as in His Word, shows himself to be the wonder-working Jehovah, fashioning all things according to the counsel of His own will, and making all subservient to His own glory and to the well-being of those who see alike His wondrous works and the wondrous things of His law. Let us ever cultivate science in this spirit—a spirit which

* I am glad to think that Sir David Baxter is about to head the way by instituting a fellowship of L.60 for natural science; and we hope that the testimonial to the late Dr Falconer will issue in the establishment of another fellowship of a similar kind.—*April* 1865.

does not in any way fetter the discoveries of science, as some have thought, but which gives them enlarged bearings as regards the creature and the Creator. The more we labour in our search after truth, the more we shall see that true science and religion are in perfect accordance, and that the light of the one reflected on the other brings out more fully the beauty and the harmony of both. We must be sure that we have discovered the facts of science before we attempt to theorise and generalise. The disputes which have arisen of late depend in a great measure on theorisings on imperfect data. No doubt theories have occasionally been the means of leading to important discoveries, and a man of imagination will be led to enter upon speculations which sometimes end in the highest results. Preconceived notions are, however, very apt to lead astray, and to make the student of nature neglect cautious induction from well ascertained facts. How many baseless fabrics have been erected which have dazzled and startled for a time, but which have crumbled to pieces with the advance of knowledge. We should never forget that there are great difficulties in the study of vital phenomena as seen in organised beings, and that we naturally arrive at a point where our researches fail, and where we must confess our inability to proceed further. The part of wisdom in such a case is to wait patiently, until future discoveries open up the path, and give security and stability to our steps. Let us ever pursue our researches in the humble spirit of those who are seeking for truth, and not in the vain-glorious strain of those who wish to magnify their own views, and to fight only for victory. It is not by bitter wranglings and painful disputations that we shall advance the cause of science. Truth does not call for such aid. The unseemly strifes of naturalists have too often brought discredit on science, and in place of advancing, have retarded its progress. Let our work be done with calmness and dignity, conscientiousness and charity; and in all our dealings with our fellow-labourers, remember the rule, to do unto others as we would that they should do unto us.

The following Communications were read:—

I. *Note on the Position of the Carpellary Groups in* Malope *and* Kitaibelia. By Alexander Dickson, M.D.

Appended to a paper on diplostemonous flowers, which I submitted to the Society in February 1864, were some remarks upon the position of the carpels in the Malvaceæ; and, among other points alluded to, were the statements of Payer as to the position of the carpellary groups in *Malope* and *Kitaibelia.* My observations on *Malope* had led me to the conclusion that Payer was in error when he described the carpellary groups in that genus as superposed to the petals,* as I found them unmistakeably superposed to the sepals. At that time I had not had an opportunity of examining *Kitaibelia.* Since then I have obtained a plant of *Kitaibelia*, and have ascertained that here the carpellary groups are superposed to the petals. I have also repeated my observations on *Malope*, and confirmed my former statement, that there the carpellary groups are oppositisepalous. It is quite evident that when Payer, in his *Organogénie*, described the carpellary groups as oppositisepalous in *Kitaibelia* and oppositipetalous in *Malope*, he had recognised the very remarkable fact of their being differently placed in the two genera, and that the inversion of the statement amounts to little more than a clerical error—an error, however, of considerable moment, from its being consistently carried out in some detail in the text of the *Organogénie.* In his *Eléments de Botanique*, however, he gives perfectly accurate figures of the relations of the parts in the two genera (p. 209). In his thesis, "*De la Famille des Malvacées*," Paris, 1852,—a considerable portion of which is reproduced in the *Organogénie*,—I find that at one part (p. 9) he states the matter perfectly correctly, thus, "dans les *Kitaibelia* les rayons de l'étoile gynobasique sont opposées aux sépales tandis qu'ils sont alternes dans les *Malope*." The points of the five-rayed star correspond to the angles of a pentagon, whose sides are the carpellary groups. At another part of the same work, however (pp. 31–32), an inversion of the statement occurs in nearly the same words as in the *Organogénie.*

* Organogénie, pp. 34–35.

In *Malope* and *Kitaibelia*, the development of the andrœcium, as regards the evolution of the staminal lobes, is essentially the same. I find that the andrœcium at first appears in both as an even rim-like cushion, pentagonal externally, surrounding the flattened termination of the floral axis, which appears as a pentagonal depression. The external angles of the staminal cushion in both genera alternate with the sepals. The essential difference between the arrangements in the two genera consists in this—that in *Malope* the five angles of the central depression are superposed to the external angles of the cushion; that is to say, the sides of the depression are parallel to the outer sides of the staminal cushion; while in *Kitaibelia*, on the other hand, the angles of the central depression alternate with the external angles of the cushion, the sides of the depression thus lying crosswise to the outer sides of the cushion. This is seen long before there is any appearance of the carpels. In both genera five pairs of lobes, alternate with the sepals, and extending longitudinally in a radial direction, are developed on the surface of the cushion, which, as development advances, grows up as the staminal tube. In the subsequent stages I have been able to confirm the statements of Payer as to the development of the stamens. On each of the lobes a longitudinal series of mammillæ appears, in a centrifugal succession, and from above downwards. Later, each of these mammillæ branches into two lobes, each of which is developed into a stamen with an ultimately one-celled anther; so that at last there are twenty rows of stamens, or, perhaps more correctly, ten rows of bifid ones. The carpellary groups form the sides of a pentagon, which in each genus correspond to the sides of the original central pentagonal depression or cavity of the staminal tube. Thus these groups are oppositisepalous in *Malope* and oppositipetalous in *Kitaibelia*. In the andrœcium, the development of five pairs, alternate with the sepals, of longitudinal series of mammillæ, and the subsequent development of each mammilla into two stamens, so exactly corresponds with what Payer has shown of the development of the stamens in *Malvaviscus*—where he has shown, besides, that the staminal tube is formed by the coalescence of five originally distinct

staminal bosses or cushions superposed to the petals, similar to those in the majority of polyadelphous plants,—that there can be no doubt that in *Malope* and *Kitaibelia*, as well as probably in all the other Malvaceæ, the andrœcium consists essentially of five compound stamens superposed to the petals. The difference in the development of the inside of the staminal cushion depends, not on any difference in the position of the compound stamens, but probably on the constitution of the central depression—that is, of the termination of the floral axis;—for it is easy to understand that the cells from which the carpellary groups are to be developed may be capable of conditioning the form of the cavity of the staminal cushion in accordance with the position of these groups. Such considerations, of course, do not at all go to explain why the carpellary groups should be differently placed in the two genera. An equally remarkable, and somewhat analogous, case occurs in the Tiliaceæ, where Payer has shown that the staminal groups are oppositipetalous in *Tilia* and oppositisepalous in *Sparmannia*.

[I take the opportunity here to call attention to the following corrections upon my paper "On Diplostemonous Flowers" above referred to:—1st, In the plate the diagram of *Polygala* is inverted, and consequently in the description of the arrangement in the text *anterior* should be read for *posterior*, *under* for *upper*, and *vice versâ*. 2d, The suggested interpretation of the arrangement in *Triphasia*, founded on Payer's statement that the carpels are oppositipetalous, must be abandoned, as it would appear from Baillon's Researches on the Organogeny of Triphasia (*Bulletin de la Soc. Bot. de France*, v. 152) that here the carpels are oppositisepalous, and that the younger stamens are the more internal.—A. D.]

II. *On the Discovery of* Trichomanes radicans *in Arran.* By Walter Galt, Esq. Communicated by Mr John Sadler.

In this communication the author doubts that this fern is native in Arran, and tries to show that in all probability the fern has been planted.

III. *Note on the Discovery of* Asplenium viride, *var.* varians, *near Edinburgh.* By Mr John Sadler.

Mr Sadler stated that, in company with Mr Naylor, he had been shown by Dr Carruthers, of Cramond, this fern

growing abundantly near that place. It was first found by Dr Carruthers there in 1862.

A letter was read from Mr William R. M'Nab, dated Berlin, 19th October 1864, in which he gave an account of the Botanic Garden there, and enumerated the principal palms grown, with their names and height.

A letter was also read from Mr William Bell, dated "Botanic Garden, Saharunpore, 15th September 1864," in which he says—"The heat of the weather here is a subject that the people in this district never weary of talking about. It is generally allowed that this season has been one of the hottest ever experienced in India. During the whole of July I never saw the thermometer lower than 88° at night, and sometimes as high as 95°, and during several days it averaged from 108° to 114° in the shade. I placed the bulb of a thermometer one day about two inches in sandy ground; in less than ten minutes it rose to 142°. The rains this season were nearly a month later of setting in than usual, and it was generally expected that there would be another famine. In some districts there has been quite an average fall, in others more scanty. In this district there has been a good fall. The rice crops will be fair, although rather late. The cotton crop will also be late; the last commodity was selling at the rate of 1s. per lb., while a few years ago any quantity could be got for 2d. per lb."

Mr I. Anderson Henry sent a pot of preserves made of the fruit of *Rubus biflorus*.

Professor Lawson, Dalhousie College, Halifax, Nova Scotia, sent specimens of *Calluna vulgaris* from St Ann's Bay, Cape Breton Island.

Dr Dickson exhibited growing specimens of *Peziza æruginosa*. The wood on which the plants were growing was of a deep green colour.

A bronze medal struck in honour of Professor Philip von Martius was presented by the Academy of Sciences of Munich.

Mr Charles Jenner exhibited a collection of dried plants, which he had made on Ben Wyvis in June last, by Mr Charles Howie, Largo, accompanied with some remarks on the flora of that mountain.

Thursday, *8th December* 1864.—Professor BALFOUR, President, in the Chair.

The following Office-bearers for 1864–65 were elected:—

President.

ALEXANDER DICKSON, M.D.

Vice-Presidents.

Professor ALLMAN.
HUMPHREY GRAHAM, W.S.
WALTER ELLIOT.
Professor BALFOUR.

Council.

F. NAYLOR.
FINDLAY ANDERSON.
JOHN KIRK, M.D.
WILLIAM SELLER, M.D.
JAMES M'NAB.
CHARLES JENNER.
ANDREW INGLIS, M.D.
F. B. W. WHITE, M.D.
S. C. MACKENZIE, M.D.
WILLIAM GORRIE.

Honorary Secretary.........ROBERT KAYE GREVILLE, LL.D.
Honorary Curator..........The PROFESSOR OF BOTANY.
Foreign Secretary...........Professor MACLAGAN.
Auditor..........................WILLIAM BRAND. W.S.
Treasurer......................PATRICK NEILL FRASER.
Artist.............................NEIL STEWART.
Vice-Secretary and Curator..............JOHN SADLER.

The following Gentlemen were duly elected Members:—

As Resident Fellows.

ALEXANDER BUCHAN, M.A.
ROBERT MACBEAN.
ALEXANDER CRAIG CHRISTIE.
E. VINCENT SANDILANDS.
HENRY TRIMEN.

As a Non-Resident Fellow.

THOMAS GLAZEBROOK RYLANDS, of Heath House, Warrington.

As a Foreign Member.

M. EDÉLSTAN JARDIN, Sub-Commissioner of Marine, Cherbourg.

Dr ALEXANDER DICKSON, President, in the Chair.

The following Communications were read:—

I. *Descriptions of New Species of Diatoms from the South Pacific.* By R. K. GREVILLE, LL.D., F.R.S.E., &c. Part III. (Plate III.)

CAMPYLODISCUS.

Campylodiscus humilis, n. sp. Grev.—Very minute; disc subcircular; costæ in a simple circular series, very fine and numerous, forming a band about half the radius in breadth; central space smooth. Diameter ·0012″. (Plate III. fig. 1.)

Hab.—Woodlark Island, in a dredging communicated by Dr Roberts of Sydney.

Among the smallest species I am acquainted with, being nearly as minute as *C. exiguus* of Grunow, considerably less than *C. parvulus*, and much more minute in its markings. The costæ are 21 in ·001″, and so fine as to resemble very delicate striæ.

MELOSIRA.

Melosira nobilis, n. sp. Grev.—Very large; frustules with rounded junction-margins, and forming a continuous filament; joints about equal in length and breadth; structure minutely cellulate, the sutural band very minutely dotted, and with a row of marginal puncta. (Plate III. fig. 2.)

Hab.—New Caledonia, in a dredging communicated by Dr Roberts.

In the hope of finding the valve of this rare and magnificent diatom, I have deferred taking any notice of it until the material kindly sent by Dr Roberts became exhausted. I can now no longer refrain from publishing so fine a species, and I hope that some more fortunate naturalist will discover the valve and complete the illustration which I now offer. Of the filament I have seen several examples with from two to four joints *in situ*. The cellulate structure is very beautiful, the small cellules being arranged in decussating lines. In the sutural band, however, the minute puncta with which it is covered are disposed in no particular order. The diameter of the filament is no less than ·0030″.

AULISCUS.

Auliscus Australiensis, n. sp. Grev.—Valve strictly circular, with strong margin, small umbilicus, and two large

roundish-oval processes; surface filled with obscure, fine, radiating striæ and extremely minute scattered puncta. (Plate III. fig. 3.)

Hab.—Shark's Bay, west coast of Australia, in stomachs of Ascidians. Dr Macdonald. Cabinet of George Norman, Esq.

The only species with which the present diatom can be compared is my *A. Macraeanus*, found by Dr Macrae in the Indian seas. It agrees with it in the strong margin, large processes, and fine radiating striæ. It differs from it in the presence of exceedingly minute puncta scattered over the whole surface, and in the total absence of the remarkable clusters of larger puncta which distinguish *A. Macraeanus*. The radiating striæ are also much less conspicuous. The diameter of the disc is ·0026″.

Rhizosolenia.

Rhizosolenia striata, n. sp. Grev.—Frustules robust, annuli distinct, striated; striæ rather coarse, oblique; terminal process short, straight, subulate. (Plate III. fig. 4.)

Hab.—Shark's Bay, west coast of Australia, in stomachs of Ascidians. Dr Macdonald.

An exceedingly fine species, rivalling in size *R. styliformis* and *imbricata*. The former it resembles very closely, not only in general appearance, but in the terminal mucro and in the form and arrangement of the annuli. When, however, the striation comes to be examined, a great difference is at once apparent. The striæ in *R. styliformis* are about 40 in ·001″; in our new species only from 18 to 20 in ·001″ and somewhat coarse. It is frequent in the small gathering obtained by Dr Macdonald from the stomachs of Ascidians; and, in the slides which Mr Norman kindly permitted me to examine from his own cabinet, I found entire frustules, some of them in the process of self-division. The length appears to vary in this as well as in the other species of the genus. Some specimens are upwards of ·0170″.

Cymbella.

Cymbella Lindsayana, n. sp. Grev.—Valves lanceolate, slightly contracted beneath the obtuse apices, often with nearly equal sides. (Plate III. figs. 5–8.)

Hab.—Near Dunedin, Otago, New Zealand, in gatherings communicated by Dr Lauder Lindsay.

A beautiful species, varying considerably in size and in relative length and breadth. Sometimes the sides are conspicuously unequal as in fig. 7, but generally, the inequality is small and often scarcely if at all perceptible; so that valves might pass for a *Navicula*, were it not for an indescribable *facies*, which to the initiated eye proclaims its true position. The apices are neither capitate nor produced, but a slight contraction just beneath them produces a very characteristic effect. As is common among species both of *Cymbella* and *Cocconema*, the frustules vary much in length and breadth. In length they range from ·0025″ to ·0035″, and in breadth the shortest specimens are often equal to the longest, the average being about ·0007″. The striæ are about 19 in ·001″. I have much pleasure in dedicating this diatom to my friend Dr Lauder Lindsay, who very kindly complied with my request to collect during his rambles in New Zealand. Other novelties occur in these gatherings, which I hope soon to prepare for publication.

NAVICULA.

Navicula Robertsiana, n. sp. Grev.—Large; valve elliptical, with obtuse ends, four slight sinuations on each side, and a marginal undulation, having the effect of a rather broad border; striæ strong, moniliform, interrupted by a linear blank line on each side of the median line, and not contracted opposite the nodule. (Plate III. fig. 9.)

Hab.—New Caledonia, in a dredging communicated by Dr Roberts.

A splendid species, belonging to the *N. Lyra* group, and marked by several good characters, among which the undulate margin is the most important. The linear blank lines are quite straight until they approach the extremities, when they gently converge towards the nodules. In the centre they are united by a broad transverse bar. Besides the blank lines there is a faint slender dark line, which runs outside of and parallel with them. The number of striæ is 12 in ·001″. Length of frustule ·0074″.

Navicula sulcata, n. sp. Grev.—Minute; valve striated, elliptical-oblong, with two marginal sinuations on each side,

and minute, suddenly produced, rounded apiculi; surface marked with about two shallow grooves between the median line and margin. (Plate III. fig. 10.)

Hab.—New Caledonia, in a dredging communicated by Dr Roberts.

This little species bears a great resemblance in form to *N. undosa* of Ehrenberg; but the valve, instead of being smooth, is distinctly, and considering its size, rather coarsely striated, besides which, the surface is marked with two longitudinal shallow grooves on each side. There is still another distinction: the apex of *N. undosa* is described as conical; in *N. sulcata* it is minutely mammilliform. The number of striæ is 19 in ·001″. Length of frustule ·0018″.

Stauroneis.

Stauroneis decora, n. sp. Grev.—Valve oblong-elliptical, gradually and slightly produced into the subacute apices; with a very slender line passing from near the ends down each side of the median line, at about a third of the distance between it and the margin; central nodule dilated into a minute, very narrow stauros; striæ exceedingly fine, parallel. (Plate III. fig. 11.)

Hab.—New Caledonia, in a dredging communicated by Dr Roberts.

A remarkably graceful diatom; very transparent, with very fine, transverse, parallel, inconspicuous striæ. The form may be defined as elongated-elliptical-oblong, the apices being so gently produced as to terminate very little beyond the point where the lateral curves would meet if continued. The slender line on each side originates at the point where the apex of the valve begins to be produced, and then passes down the valve with a very slight curve. The median line is also very slender, a little thicker towards the centre, where it is crossed by a minute, short, very slender stauros. Length of the valve ·0055″. This species is evidently allied to *S. australis*, described in Part II. of this series of Papers, but is distinguished at once by its form, the much finer striæ, and the two slender lines on the valve. The minute but well-defined stauros is alike in both; it is indeed so small as to bring both species very close to *Navicula*, and it must be confessed that the two genera have a tendency

to run into each other. Even in a single species, such as *S. pulchella*, specimens occur which might be referred to *Navicula*, while others are exactly intermediate.

Stauroneis (?) *obesa*, n. sp. Grev.—Small; valve broadly oval, the ends somewhat truncate, and terminating in small suddenly produced conical apices; striæ very fine, parallel; stauros short, linear-oblong, indefinite. (Plate III. fig. 12.)

Hab.—Curteis Straits, in a dredging communicated by Dr Roberts; Shark's Bay, in stomachs of Ascidians, Dr Macdonald.

The present subject affords another illustration of the ambiguity of the distinction between *Stauroneis* and *Navicula.* Here the stauros is quite indefinite, and consists of a mere lateral thickening of the nodule, causing a reflection of the light. Some valves show a very slight undulation of the margin, as represented in the figure, but as others appear to be entirely without it, I have not rested any part of the diagnosis upon this character. Striæ 21 in ·001″. Length ·0020″.

Donkinia.

Donkinia reticulata, Norm.—Large; linear-lanceolate, with sub-obtuse apices; median line strongly diagonal at the centre, then marginal for more than a third of the length of the valve; striæ oblique, distinct. (Plate III. figs. 13, 14.) *Donkinia reticulata*, Norm., in Pritch. Inf. 1861, p. 921.

Hab.—Shark's Bay, West Australia, in stomachs of Ascidians, Dr Macdonald; Woodlark Island, in a dredging communicated by Dr Roberts.

The finest species of a very interesting genus, established by my friend Mr Ralfs in the fourth edition of Pritchard's Infusoria, for the reception of a small group of diatoms intermediate between *Pleurosigma* and *Amphiprora.* I am delighted with the opportunity which noble specimens in the Woodlark Island dredging afford me, of adding a figure to Mr Norman's description. The length of the frustule varies somewhat, but is generally about ·0062″. The striæ are from 20 to 22 in ·001″.

Mastogloia.

Mastogloia Macdonaldii, n. sp. Grev.—Valve elliptical-

rhomboid, with acute apices; loculi remote, 10–12, between which and the median line are two lines (one on each side), following the outline of the valve, and slightly contracted in the centre, where they are united by a broad stauros-like bar. (Plate III. fig. 15.)

Hab.—Shark's Bay, Australia, in stomachs of Ascidians. Dr Macdonald.

I much regret that after a minute examination of the slides in my friend Mr Norman's cabinet, as well as of those with which he was good enough to present me from the same source, I did not succeed in discovering the front view of this very distinct species. The characters, however, already given are amply sufficient to distinguish it. The loculi are delicate, and at first sight not conspicuous, and until they are perceived, the valve has much the appearance of a minute *Navicula*, belonging to the *N. Lyra* group. Length of frustule ·0024″.

DESCRIPTION OF PLATE III.

Fig. 1. *Campylodiscus humilis.*
2. *Melosira nobilis.*
3. *Auliscus Australiensis.*
4. *Rhizosolenia striata.*
5–7. *Cymbella Lindsayana*, vars., . . side view.
8. „ „ . . . . . front view.
9. *Navicula Robertsiana.*
10. „ *sulcata.*
11. *Stauroneis decora.*
12. „ *obesa.*
13. *Donkinia reticulata*, ... front view.
14. „ „ . . . . . side view.
15. *Mastogloia Macdonaldii.*

All the figures are × 400 diameters.

II. *Report on the Cultivation of the Quiniferous Cinchona at Darjeeling.* By Dr THOMAS ANDERSON, Calcutta.

Dr Anderson reports on the successful cultivation of cinchona at Darjeeling. The following was the number of plants in cultivation there on 15th July 1864:—*Cinchona succirubra*, 4904; *C. Calisaya*, 172; *C. officinalis*, 10,460; *C. micrantha*, 1705; *C. Pahudiana*, 2275. The spot on

which the open-air cultivation of cinchona is carried on by government is on the south-eastern slopes of a long spur from Sinchal, 3743 feet above the level of the sea. Private individuals are also cultivating the cinchona at Darjeeling.

III. *Report on the Cinchona Operations in the Neilgherries.* By Mr W. G. M'Ivor.

Mr M'Ivor reports in regard to the cultivation of cinchona at Ootacamoond, on the Neilgherries, as follows:—

1. *Cinchona succirubra*, red bark, 102,344 plants.
2. *Calisaya*, yellow bark, 2137.
3. *officinalis* var. *Condaminea*, original loxa bark, 4494.
4. *officinalis* var. *Bonplandiana* (*C. chatmarguera*), select crown bark, 232,980.
5. *crespilla*, 1927.
6. *lancifolia*, Pitayo bark, 12.
7. *nitida*, 8426.
8. sp., 2769.
9. *micrantha*, 11,561.
10. *peruviana*, 3176.
11. *Pahudiana*, 425.

Mr M'Ivor also gives an account of the price of the bark of each in the London market, and of the comparative growth of the plants, as well as of the mode in which they have been distributed.

IV. *Account of a Trip to Travancore, Coonoor, &c.* By Dr Alexander Hunter, Madras.

Dr Hunter's party consisted of thirteen persons—photographers, an artist, an industrial pupil, a gardener, &c. Dr Hunter describes the scenery of the country through which they passed, and various industrial products, both vegetable and geological. Among the plants observed were *Arachis hypogœa*, *Andropogon Calamus aromaticus* or Roussa, *A. Schœnanthus* or lemon grass, *Agave americana*, *Fourcroya gigantea*, *Acacia arabica* or Babool, *A. Sundra*, *Cœsalpinia Sappan*, *C. coriaria*, *Inga dulcis*, *Lawsonia alba*, *Jatropha Curcas*, *J. multifida*, species of *Opuntia*, *Euphorbia Tirucalli*

or milk hedge, *E. Cuttimandoo.* These Euphorbias in the young state are eaten by goats.

In the vicinity of Vellore the hills begin to assume a great variety of bold, picturesque forms, and they run in ridges branching off in different directions, chiefly to the west. The peaks attain an elevation of 2600 to 3000 feet, but there is little tableland on the hills, and only a scanty supply of low scrubby vegetation. The rainfall at Vellore and the vicinity is considerably greater than at Madras, and the luxuriance and size of some of the trees attest this. There are a few that attain a considerable size in the avenues, as two species of Bassia, the *longifolia* or Illoopy and *latifolia* or Eppei, both handsome shady trees, with fine broad tops that contrast well with the common Banian. These trees, yield a great profusion of seed; from which good oils for soap-making can be expressed. The seeds are brown, oval, and pointed, with a bitter nutty flavour. The Margosa or Neem (*Melia azadirachta*) is another tree that attains to a great size at Vellore, and yields a timber almost equal to mahogany, and often with better blaze-marks, if the wood is old. One of the largest and most showy trees of Vellore is the Naga or *Syzygium jambolanum*, which yields a fine timber, and a purple plum much eaten by the natives. This is a sweet and astringent fruit, very like the damson, and likely to make a good substitute for it. Another useful timber tree that thrives in this district is the soap nut (*Sapindus emarginatus*). The wood of this is very hard, well blazed, pale grey and yellow in colour, difficult to work, but taking a fine polish, and very durable. This is a hardy and shady tree, and ought to be more extensively planted in avenues for its timber. The soil about Vellore seems to be fertile, judging from the fine crops of Indian corn, tobacco, and paddy that are produced. The dense tops of large trees in the vicinity also attract attention even at a distance. But the chief interest of the station is associated with the fort and pagoda, which were built in the year 1365 by an inhabitant of Vizianagram named Bommi Reddi; he was a good soldier, and assisted the inhabitants of the town in capturing a large gang of robbers who had pillaged their property and were concealed in the neighbouring forest, where the fort now stands.

On attaining an elevation of 2000 feet at Ahtoor, the jungle begins to be less dense, and the character of the trees changes—only here and there a giant Bombax with its angular horizontal branches, or a more feathery Eriodendron with its graceful hanging leaves and curious prickly bark, may be seen towering above the stunted shrubby acacias, while here and there the gigantic leaves of the teak, or the soft velvety-leaved abutilon with fine large yellow flowers, form pleasing contrasts of foliage. A few showy Ipomœas and Thunbergias take the place of the Convolvuluses of the plains, and the gigantic pods of the *Entada Pursætha* or the large trifoliate leaves of the Canavalia or sword-bean may be seen in refreshing luxuriance. Dr Hunter also gives an account of the geological features of the country, and describes various rocks useful for pottery and for building purposes.

V. *Report on the Working of the Government Tea Factories and Plantations in the North-Western Provinces during* 1863–64. By WILLIAM JAMESON, Esq., Surgeon-Major.

Mr Jameson describes the manner in which the Government tea plantations and factories in the Kohistan and Doons of the North-Western Provinces have been worked during the year ending May 1864. The total yield of tea in Dehra Doon, Kumaon, and Kangra has been 66,352 lbs. The plantations have also yielded upwards of 85 tons of seeds.

The teas at Dehra Doon and Almorah are classified under souchong, pouchong, bohea, hyson-skin, and young hyson. Mr Jameson calculates that the produce of seeds in the Kohistan of the North-Western Provinces last year was 2361 maunds, and that each maund contains 24,000 seeds. Supposing that 4000 seedlings were required for an acre, Mr Jameson calculates that he might have upwards of 42 millions of seedlings, which would supply upwards of 10,000 acres. In thirty or forty years the Kohistan of the Punjaub and of the North-Western Provinces might produce tea equal in quantity to the whole export trade of China. With good cultivation and good land, 300lb. of tea per acre might be easily obtained.

Photographs of the tea plantations in Kangra, sent by Dr Cleghorn, were exhibited.

VI. *Extracts from Botanical Correspondence.* Communicated by Mr JOHN SADLER.

1. Letter from Mr John S. M'Kay to Mr M'Nab, dated New Quito Cinchona Plantation, 11th August 1864, in which he gives a full account of a trip he had made from the Neilgherries to Holta, near the base of the Himalayas, a distance of nearly 2000 miles, with several cases of young plants of Cinchona destined for the new plantation there. The proposed plantation is at present under a dense forest of *Pinus longifolia.*

2. Letter from Mr A. Denham, dated Botanic Garden, Madras, 13th September 1864, in which he says—"I had the pleasure of a trip to Bangalore on 9th August. The distance is about 200 miles, and the transit much better than formerly, as the whole route of railway is now open, on account of which there was a splendid entertainment at Bangalore on the 10th, held in the public hall. I stayed with the superintendent of the Lal Bagh Garden. The climate is one of the best in southern India. The gardens are very extensive, and are laid out quite in the English style, and contain many species of our home-grown plants. All bedding-out plants do well. Scarlet geraniums stand many years. Roses are the gem of the gardens, and the show they make nearly all the season over is superb. Araucaria and Cupressus do very well. *Meyenia erecta* and *Plumbago rosea* make splendid hedges, and for edgings the *Gendarussa vulgaris* is little behind the English boxwood. The oak and ivy recently introduced are thriving well. Strawberries produce abundance of fruit. Apples and pears bear two crops yearly, but the fruit is small and the plants assume the form of bushes. Grapes are a very indifferent crop. Climbers, such as Tecomas, Bignonias, Thunbergias, and many leguminous plants, do well. There are few palms, and not so many flowering trees as we have in the plains. On my return to Madras I took the night train, and could not help thinking myself at home again, particularly when I found myself in a railway carriage (English-make) with other Europeans, and travelling through what was very like some of our Scotch scenery. The moon was full, and the pace at which we came down some of the sharp inclines

with the steam shut off, was very rapid. We left Bangalore at 7 P.M., and reached Madras at 6.30 next morning."

3. Letter from Dr B. Carrington, Prestwick, in which he refers to having found *Scirpus Watsoni* and *S. uniglumis*, both growing together in the same field at Southport, during the autumn of 1863, and differing in no respect except in the bristles.

4. Letter from the Rev. James Fraser, Colvend Manse, giving an account of a botanical trip to the Isle of Skye in July last. He reports having found *Lathræa squamaria* growing on the face of a brae, close to a little bridge near the Inn of Dunvegan, in a spot where the *Orobus sylvaticus* grows abundantly. An English gentleman there, Mr A. N. Preston, had shown him a specimen of *Dryas octopetala*, which he had collected about two and a half miles from Broadford, on the road to Torrin.

5. Letter from Dr James Stirton, Glasgow, referring to several rare mosses which he had recently collected, and more especially to *Grimmia commutata*—a moss new to Britain, which he picked in July last on Moncrieffe Hill, near Perth. It has not yet been met with in fruit. Specimens of the mosses were exhibited.

Mr M'Nab exhibited sections of various trees which had been blown down in the Botanic Garden by the late storm, and remarked that, during the severe north-easterly gale which visited this district on the 23d of October last, several trees in the Botanic Garden were uprooted. One of these was a fine Corsican pine (*Pinus Laricio*), 50 feet high, and 5 feet in circumference at base, 4 feet 9 inches at 4 feet above ground, and 4 feet at 18 feet above the surface. This tree was thirty-three years old, and shows on its stem thirty-three distinct semi-spiral whorls of branches. The tree grew on a deep bed of sand, but the roots do not seem to have penetrated below that portion of soil originally trenched. The straight stem and regular growth of the Corsican pine recommend it for more general cultivation than it at present receives. In more favourable soils and situations this tree is advantageously employed for railway sleepers and other useful purposes twenty years after being planted. The timber is heavy and full of resin. Planters of the Corsican

pine on an extensive scale would do well to obtain their plants raised from native seeds in preference to those ripened in this country. The trees in the Botanic Garden, of which two now remain, were originally raised from native seeds.

The same gale which uprooted the Corsican pine also destroyed the large *Tilia americana* (pubescent variety). This tree was considerably damaged by frost during the ever-memorable winter of 1859–60, when the bark and wood were much split up; since then, the foliage of this tree was observed every year becoming smaller, and the flowers produced were in the utmost abundance. It had an unbranched trunk, 9 feet high and 5 feet 8 inches in circumference, and afterwards branched to the height of 38 feet, and 40 feet was the diameter of its branches. The annual rings show the tree to be seventy-six years old. It was removed from the Botanic Garden, Leith Walk, during 1822, when of large size—viz., thirty-four years old. The annual rings formed for two or three years after planting are very close and small when compared with those formed before removal and after being three years planted.

Mr M'Nab exhibited portions of an earthenware drain choked with the roots of an elm tree, and stated that during the year 1848 an earthenware drain-pipe, having a 4-inch bore, was laid from the winter-house in the Experimental Garden, to convey the surface water from the stokehole and rain-water cisterns. Lately, some new works have been going on which necessitated an examination of this drain, when upwards of 80 feet of it were found to be entirely choked with the roots from two young elm trees, which were planted in the neighbourhood soon after the drain-pipes were laid down. The drain was 8 feet 6 inches under the surface of the ground, and laid on a bed of undisturbed sand, having all the joints filled with prepared clay. Through one of the clay joints the elm roots had entered, and extended themselves 40 feet in each direction. As the choking of drain pipes with tree roots is a very common occurrence, and frequently causes much inconvenience, it would be well if parties laying drain-pipes from dwelling-houses, particularly if trees are to be planted or already exist in the neighbourhood, had the joints filled with cement instead of clay.

No matter what depth the drains are laid under the surface, roots, particularly elm, will be sure to find their way to them.

Mr Gorrie exhibited specimens of the following plants in flower and fruit in the open air on 8th December:—New Zealand spinage, *Oxalis crenata*, Indian cress, borage, Cape gooseberry, common radish, knotted marjoram, alpine strawberry, common yellow crocus.

Dr F. B. W. White sent specimens of *Oxytropis Halleri*, collected by him on Ben Chonzie in September last, at an elevation of about 2200 feet.

Mr W. H. Symes presented specimens of *Leptogium Schraderi*, a rare lichen, collected by him near Albury in August last; and a slide containing some good diatoms.

Dr Greville presented a specimen of Chorda Filum β collected by Mrs Gray at Swanage. This sea-weed generally is found growing in comparatively shallow water, in long cords, sometimes stretching for several yards, but when the plant is located in deep water these cords coil upon themselves so as to form an inflated bag.

A photograph of a fine specimen of *Ficus religiosa*, sent by Dr Cleghorn, was exhibited.

Professor Balfour noticed the addition to the University herbarium of a large collection of plants from Southern Syria, collected by Mr B. T. Lowne during 1863-64.

12th January 1865.—Professor Balfour, Vice-President, in the Chair.

The following gentlemen were elected Fellows of the Society:—

Robert Hutchison, Esq., of Carlowrie, F.R.S.E.
R. T. Mackintosh, Esq.
C. Currie Ritchie, Esq.
John Menzies, Esq.

The following donations to the Museum at the Botanic Garden were noticed:—

From Dr John Gray, R.N.—Specimen of "Palloo" (hairs of *Cibotium Schiedeanum*), from the Sandwich Islands.

From James Ritchie, Esq., C.E., Perth—Specimens of Conferva from Strathpeffer.

From Mrs Balfour—Bag ornamented with various leguminous seeds.

From Mr Archibald Gorrie, forester, Holkham Hall—Cones of *Picea Webbiana*, *Sequoia sempervirens*, and *Cryptomeria japonica*, ripened there.

The following additions to the University Herbarium were announced:—

From C. Eyre Parker, Esq.—A large collection of English plants.

From Sir David Brewster—Specimens of *Cassia Brewsteri* (F. Mueller), from Burdekin River, Australia, transmitted by Dr F. Mueller, director of the Melbourne Botanic Garden.

From Mr P. K. Vartan, medical missionary, Nazareth—Specimens of *Capparis spinosa*, the Hyssop plant of the Bible, and specimens of the ordinary hyssop (*Hyssopus officinalis*), from Palestine.

From Mr W. W. Evans—Specimens of *Helminthia* (*Picris*) *echioides*, from Tynefield, about 3½ miles west from Dunbar.

Fasc. XII. of Leighton's "Lichenes Britannici Exsiccati" has also been added.

The following donation to the Library was laid on the table:—

Proceedings of the Royal Horticultural Society, vol. iv. No. 12; vol. v. No. 1.

The following Communications were read:—

I. *Account of Excursions to the Mountains at the head of Lochlomond, to Ben Lawers and the Sow of Athole, in August and September* 1864. By Professor BALFOUR.

In this paper the author gave an account of an excursion made with pupils to Inverarnan, at the head of Lochlomond; and of excursions to Ben Voirlich, Benmore, Binnain or Stobbinnain, the Cobler, Benima, and the shores of Lochlomond, from August 9th to 13th. The party consisted of Professor Balfour, Messrs P. Neill Fraser, T. L. Brunton, F. W. Moinet, John P. Gordon, and James Thomson. Among the more interesting plants noticed were the following:—*Sagina nivalis*, on Binnain, along with *Draba rupestris*, *Carex vaginata*, and *Polypodium alpestre*,

also *Saxifraga nivalis*, *Carex pulla*, *Polystichum Lonchitis*, *Poa Balfourii*, and various species of Sagina. On Ben Voirlich all the ordinary alpine species were collected. On the Cobler, the party collected *Saussurea alpina*, *Draba incana*, *Polystichum Lonchitis*, *Hymenophyllum Wilsoni*, and *Cryptogramme crispa*. On August 20, Dr Balfour visited the mountain called the Sow of Athole, and gathered on it *Phyllodoce cærulea*, *Azalea procumbens*, *Lycopodium annotinum*, *Cornus suecica*, and other alpine plants. On 25th August he made an excursion to Ben Lawers, and found abundance of *Sagina nivalis* on the spot where he had gathered the plant in 1847. He also picked *Saxifraga cernua*, *Draba rupestris*, and numerous other alpine species. Along with *Sagina nivalis* were gathered *S. procumbens*, exhibiting very interesting forms; *S. saxatilis*, *S. subulata*, and *Alsine rubella*. Some of the forms of Sagina seem to require special examination. Specimens of the plants were exhibited, and remarks were made on the local distribution of plants in Scotland, specimens being shown of species confined to single localities, and of others only found in two or three places.

II. *Notice of a species of Dilivaria (Acanthus) sent from Old Calabar by* Mr A. Hewan, *Medical Missionary, and now flowering in the Edinburgh Botanic Garden.*

This acanthaceous plant belongs to the true Acanthus section, as described by Dr T. Anderson of Calcutta, in his valuable paper on Acanthaceæ. It resembles *Dilivaria* (*Acanthus*) *ilicifolia* of Jussieu, but differs from it in its larger oblong-lanceolate leaves which are sinuately lobed, and have ovate acute segments. It is apparently *Acanthus montanus* of Anderson. The plant has showy pinkish flowers, with large bracts having spiny teeth. The upper bract is larger than the lower. Calyx bilabiate, upper lip large; corolla unilabiate, upper lip being undeveloped, stamen didynamous; anthers unilocular, with a bearded margin; base of style with a hairy sheath.

III. *Notice of* Rosa alpina (*Deseglise*) *found naturalised near Perth.* By F. B. W. WHITE, M.D.

Dr White stated that he had gathered this rose in the depth of the woods, on Kinnoul Hill, near Perth, where it seems to have fairly established itself. He gave a description of the plant and exhibited specimens from the locality. The plant is not uncommon on the Continent.

IV. *Extracts from Botanical Correspondence.* Communicated by Professor BALFOUR.

1. Letter from Mr Henry Beecroft Harvey, giving a description of the country near Glenelg, Queensland, Australia.

2. Letter from Mr William R. M'Nab, giving a description of the microscopical arrangements in Professor Virchow's class of Histology at Berlin.

3. Letter from the Rev. James Farquharson, noting some of the rarer plants which occur in the neighbourhood of Selkirk, among which are *Trientalis europæa, Neottia Nidus-avis, Lathræa squamaria, Plantago media, Blysmus compressus*, &c.

Mr Sadler exhibited specimens of *Cystopteris fragilis* var. *interrupta*, which he had picked in Glen Farg, near Bridge of Earn, in 1863.

Dr James Stirton, Glasgow, sent specimens of *Mnium cochlearifolium*, found by him on the hills behind Dunoon.

Specimens were exhibited of *Sagina ciliata* (Fries) and *Arenaria leptoclados* (Guss.), which had been transmitted from Old Machar, Aberdeenshire, by Mr John Sim; also specimens of *Simethis bicolor* (Kunth), from Bournemouth, and of *Phalaris paradoxa* (L.) from Swanage, transmitted by James Hussey, Esq. of Salisbury.

Mr John M'Donald exhibited a peculiar monstrous condition of a double Roman Narcissus.

Dr Greville sent a specimen of the common Carnation exhibiting monstrosity in flowers, all the floral envelopes being changed into scales or bracts.

Professor Balfour announced the painful intelligence of the death of Dr W. Balfour Baikie, one of the early members of the Society, who had distinguished himself by his discoveries in Africa. He died of dysentery at Sierra Leone on 30th November last. Dr Baikie had been elected a Fellow of the Society on 11th February 1847.

9th February 1865.—Professor Balfour, V.P., in the Chair.

The following donations to the Library were laid on the table:—

Analytical Drawings of Australian Mosses, Fasc. 1, by Ferdinand Mueller, Ph.D., M.D., &c.—From the Author.

The Vegetation of the Chatham Islands, by Ferdinand Mueller, Ph.D., M.D., &c.—From the Author.

Transactions of the Royal Society of Arts, Vol. VI., part 4.—From the Society.

Verhandlungen des Naturforschenden Vereines in Brünn, Band II.—From the Society.

The following donations to the Museum at the Botanic Garden were noticed:—

From Thomas Patton, Esq., Glenalmond—Cones of *Pinus monticola*, taken from young grafted trees three or four years old.

From Robert Liddle, Esq.—Various fruits and seeds from Africa.

From Surgeon-Major Rae—Twin apple, produced at Lochiehead, Fife.

From Dr Murchison—Watch-chain made of shell-lac.

From Thomas Thomson, Esq.—Cones of *Abies Menziesii*, ripened at Keillour, Perth.

Before commencing the public business, Professor Balfour alluded to the loss which the Society had sustained in the death of Dr Hugh Falconer, which melancholy event took place in London on 31st January last. Dr Falconer was a native of Forres; he graduated in Edinburgh in 1829, and wrote a thesis on chorea. He became a fellow of the Botanical Society in July 1841. He had distinguished himself in India as superintendent of the Botanic Gardens

of Saharunpore and Calcutta, and by his valuable palæontological researches in regard to mammalia.

The following Communications were read:—

I. *Contributions to the Flora of Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S.

Abstract.—The following remarks have reference mainly to a collection of *Flowering Plants and Ferns*, made in 1861* (October to December) in the district between Dunedin and the Clutha (East Coast).

When (in 1861) I visited Otago, almost nothing could be said to be known of the Flora of the *settled districts* of the *east* coast, or generally of the *interior* of that Province.† All that was then known of its botany was concentrated in Dr Hooker's magnificent "Flora Novæ Zelandiæ,"‡ and was the fruit of the collections made by the Naturalists of various survey or exploring expeditions sent from this country.§ Of these contributions to the Otago flora, the most recent, as well as in all respects the most important, are those of Dr Lyall of H.M.S. "Acheron," made mostly in 1851. The only locality he visited on the *east* coast was Otago Harbour, whose *shores* he botanised; and this appears to have been the *only* collection made on the *east* coast previous to my visit in 1861. But on the *west* coast he explored most of the larger fjords with which it is indented, and of a series of which it may be said to consist. His predecessors in the botanical exploration of the *west* coast of Otago (for none of them had visited the *east* coast) had apparently all been confined to Dusky Bay, which is a classical name in the flora of Otago in connection with the voyages of the celebrated navigators Cook and Vancouver. Dr Lyall was there-

* When not otherwise specified, all my remarks must be held to refer to this date,—that of my own visit and collections.

† With the exception of certain portions of the *coasts* of Otago, to be hereafter specified, the flora of the *south* island of New Zealand was virtually unknown *south of Akaroa* (Banks's Peninsula), in the Province of Canterbury.

‡ Vol. i., containing "Flowering Plants and Ferns," published in 1853.

§ 1. Sir Joseph Banks and Dr Solander: Captain Cook's first expedition, 1769. 2. Forsters, father and son, and Dr Sparrmann: Cook's second voyage of discovery, March 1773. 3. Dr Anderson: Cook's third voyage, 1776–1780. 4. Dr Menzies: Captain Vancouver's expedition.

fore the only botanist who had an opportunity of visiting localities along the whole west coast of Otago, and who ascended, sometimes to a height of 3000 or 4000 feet, the mountains which bound its fjords. Some of the localities visited from the sea by the distinguished naturalists who were the earliest contributors to the Otago flora, have apparently not been since revisited, and there are therefore not a few of the peculiar plants of the west coast which have been, up to this date, collected only by these botanists.

My own collections were made in the *settled districts* between Dunedin, the capital of the province, which is situated at the head of Otago Harbour before mentioned, and the magnificent Clutha river, the Tay of New Zealand. This represents a parallelogram of country about sixty miles long by twenty broad. It may be characterised as the *Lowlands*, or *district of the plains*, in contradistinction to the west coast region, which is that essentially of deep fjords with lofty mountain walls. The *east* coast belt alluded to includes the great plains of the Taeri, Tokomairiro, and Clutha, as well as the upland districts of Greenisland, Saddlehill, Tuapeka, and others. It contains few hills of an elevation higher than 1500 feet, and consists virtually of a succession of plains and gentle uplands. Its flora may be held to represent, so far as it goes, that of the eastern seaboard, eastern plains, and generally the settled districts of Otago. But it differs materially from that of the western alps, which rise to 9000 feet; of the central great lake basins; and of the western fjords—whose flora has, generally speaking, an alpine or sub-alpine character.

The "Flora Novæ Zelandiæ" records 104 species of flowering plants and ferns, as occurring on the *coasts* (mostly *western*) of Otago. Of these, 34 species, or 32·68 per cent., were found by me in the *eastern* districts, and are therefore probably generally distributed over Otago. But the majority are peculiar to the western alps or fjords. They include some of the most characteristic and most beautiful herbaceous plants of Otago (*e.g.*, species of *Olearia*, *Celmisia*, *Senecio*, and *Cordyline*).

In addition to the species recorded in the "Flora Novæ Zelandiæ," as occurring in Otago, it mentions 193 species as "abundant throughout the islands," as "common in the

middle and north islands;" or otherwise in such terms, *quoad* their geographical range, as to lead to the inference that they are to be looked for in Otago. But it is unsafe to found much on this category; for, on comparing the "Flora Novæ Zelandiæ," published in 1853, with the "Handbook," issued only a few months ago (1864), I find that there have been in many instances essential modifications of the expressions in question; and that there are in many cases no proofs up to this date that the species so described occur in Otago.

(Here followed in the MSS. a systematic enumeration of the phænogams and ferns collected by the author during his excursions.)

Total Natural Orders, . . .	58
„ Genera, ...	147
„ Species, ...	235

Analysing the list in question, with a view to set forth in an abstract form the peculiarities of the flora of the eastern seaboard of Otago, it has to be remarked, in the first place, that five species are *new to science*, viz.,—

1. Viscum Lindsayi. Oliver.
2. Celmisia Lindsayi. Hook. fil.
3. Poa Lindsayi. Hook. fil.
4. Aciphylla Colensoi. Hook. fil.
5. Crepis Novæ Zelandiæ. Hook. fil.

Of these, the first three were not previously known as natives of New Zealand or other countries. Of the other two, *Crepis Novæ Zelandiæ* had been previously collected in Queen Charlotte's Sound, and *Aciphylla Colensoi* in various parts of the alps of the north and south islands (2000 to 5500 feet in the latter). Three species previously undetected in New Zealand or elsewhere—new to science—may be regarded as very insignificant fruits or results from the botanical exploration of a district of a country botanically new—up to this period virtually an untrodden field. But the number is considerable when we remember—1. That Dr Hooker had pointed out, as the result of his investigations during the preparation of his *magnum opus*, the New Zealand Flora, that *novelties* were to be looked for only in the southern *Alps;* 2. That this was the region of the plains, where we could only look for an extension of

the flora of Canterbury and Nelson, both of which provinces had been much more fully, in their interior at least, botanised than Otago ; 3. That this was the region of settlement, in which the progress of cultivation was likely to lead to the disappearance of the rarer or less hardy native herbaceous plants, with a corresponding introduction of the more robust emigrants of Britain or Europe. I venture to bring this point somewhat prominently forward for the encouragement of the *local botanist*, who must not be dissuaded from *collecting* under the impression that the work of botanical examination in Otago has been completed, and that no novelties remain to reward his labours. Even should he fail in the *discovery of species new to science*—and this is not likely, at least at any distance from Dunedin—he is almost certain to add new species to the flora of Otago—plants, that is, hitherto undetected within its borders, though found in other parts of New Zealand; and he is thus sure of contributing materially to our present imperfect knowledge of the geographical range of species in that province, as well as in the New Zealand islands in general.

I estimate that to the Otago flora, as it is at present known, which amounts to 591 species in the department of Phænogams and Ferns, *at least a hundred species remain to be added by local botanists.*

My list of Otago plants contains several contributions to the *geographical botany* both of Otago and New Zealand. For instance—

1. **Poa breviglumis**

is not recorded at all in the New Zealand Flora as a native of New Zealand, though it appears in Dr Hooker's "Flora Antarctica."

2. **Juncus australis,**
3. **Luzula Oldfieldii,**
4. **Carex Gaudichaudiana,**

find no place in the "Flora Novæ Zelandiæ," but are recorded in Dr Hooker's "Flora Tasmaniæ."

5. **Potamogeton heterophyllus**

does not appear in the "Flora Novæ Zelandiæ," but is a British plant, occurring also in Tasmania, and in various temperate regions throughout the world.

Again, the following had not been previously found, or recorded as having been found, in Otago; and not a few of them appear in the "Flora Novæ Zelandiæ" as north island plants only:—

1. Clematis Colensoi, and *var.* rutæfolia.
2. Hypericum japonicum.
3. Myriophyllum elatinoides.
4. Mesembryanthemum australe.
5. Coprosma rotundifolia.
6. Asperula perpusilla.
7. Lagenophora pinnatifida.
8. Myosotis antarctica.
9. Mimulus radicans.
10. Podocarpus dacrydioides.
11. Typha angustifolia.
12. Ruppia maritima.
13. Carex testacea.
14. Carex lucida.
15. Echinopogon ovatus.
16. Dichelachne crinita.
17. Agrostis quadriseta.
18. Arundo conspicua.
19. Deschampsia cæspitosa.
20. Hymenophyllum crispatum.
21. Hypolepis tenuifolia.
22. Azolla rubra.

Not the least interesting feature in my collection of 1861 is the circumstance that no less than twenty-five species, or 10·63 per cent. of the whole, are *British* plants, which are equally indigenous to New Zealand. In some of these cases, it will be observed, the *type* only is British, while the *variety* or *form* is peculiar to New Zealand. In others, however, the type, as well as its dominant forms, are equally common to Britain and New Zealand. All are herbaceous, hardy plants; of which it is to be remarked that ten of the twenty-five, or 40 per cent., are aquatics or semi-aquatics, growing in water, marshes, or by the sides of streams, both in Britain and New Zealand, while one or two, which do not generally inhabit such localities in Britain, were found by me frequenting them occasionally in Otago.

In addition, however, to these twenty-five British plants which are *natives* of Otago, and of New Zealand generally, I met with the following familiar British plants, or weeds, growing more or less in a wild state, which have been introduced by man apparently, and are now, or are becoming, *naturalised*:—

N. O. 1. Gramineæ—
1. Poa annua, L.
2. Festuca bromoides, L.
3. Lolium perenne, L.
4. Anthoxanthum odoratum, L.
5. Holcus mollis, L.
6. Phalaris canariensis, L.
7. Alopecurus agrestis, L.
8. Phleum pratense, L.

N. O. 2. Polygoneæ.
9. Rumex acetosa, L.

10. R. acetosella, L.
11. R. crispus, L.
12. R. obtusifolius, L.

N. O. 3. Caryophylleæ—
13. Stellaria media, Sm.
14. Cerastium glomeratum, Thuil.
15. C. viscosum, L.
16. Spergula arvensis, L.

N. O. 4. Cruciferæ—
17. Brassica oleracea, L.
18. B. campestris, L.
19. Nasturtium officinale, L.
20. Capsella bursa-pastoris, L.

N. O. 5. Leguminosæ—
21. Trifolium repens, L.
22. T. pratense, L.
23. Vicia sativa, L.

N. O. 6. Plantagineæ—
24. Plantago lanceolata, L.
25. P. major, L.

N. O. 7. Geraniaceæ—
26. Erodium cicutarium, L.

N. O. 8. Urticaceæ—
27. Urtica urens, L.

To these might be added a few escapes from cultivation, individual specimens whereof were found here and there. It is, however, unnecessary further to specify the British plants which are, or are being, naturalised in Otago. Every year is adding to their number; their progress, indeed, is co-extensive with the progress of settlement and cultivation.

These hardy immigrant plants are rapidly and extensively *dis*placing and *re*placing the more delicate and rarer herbaceous natives of Otago and of New Zealand, as is the parallel case with the New Zealand *fauna*. In all cases this is to the detriment of *science ;* for many of the native plants and animals of New Zealand are rapidly becoming as rare or as extinct as the *Moa*. In the majority of cases, too, it is to the detriment of the *colonist*, whose fields or pastures are destroyed by the luxuriant intruders; though in certain exceptional cases (*e. g.* that of the pasture grasses and clovers), he is decidedly and largely benefited, there being no comparison in nutritive value between the British emigrant food plants and the native pasture plants of New Zealand.

Recapitulation.—For the encouragement of the *local botanist* assiduously to *collect*, however unpromising apparently may be the circumstances under which his collection is to be made, it may be here repeated concisely, or in the form of an abstract, that a comparatively small area in the lowland and settled districts of Otago, in the vicinity of the capital (for though my collections were made at various points within the parallelogram already described, they

were, for the most part, from the Greenisland and Saddlehill districts, within ten miles of Dunedin), yielded, at an unfavourable season for collecting, 235 species of flowering plants and ferns, of which 5 were new to science; 5 had not been previously found in New Zealand; 22 had not been previously found in Otago; 30 were rare in Otago or New Zealand, or exhibited other interesting peculiarities of geographical distribution;* 25 were *British* plants; in addition to which, and to the 235 native plants, 27 *British* plants were found *naturalised*.

II. *Remarks on some Seedling Coniferæ raised from seeds ripened in Britain.* By Mr M'Nab.

Mr M'Nab remarked: For some years past my attention has been directed to the Coniferæ raised from seeds ripened in Britain, and I have now the honour to lay before the Society some observations relative to the few species which have come under my notice, accompanied with a series of living specimens of each variety, showing the various stages of degeneracy, as well as the diversity of forms, which some of them assume. Beginning first with the *Abies Douglasii*, some of the specimens are taken from the trees originally introduced by the late Mr David Douglas, the botanical collector; some from seedlings introduced from North-West America during the last ten years; and some from plants (eighteen in number) raised from seed ripened in different districts of Scotland, and now growing in the Botanic Garden. The original trees in the Botanic Garden (introduced by Douglas), as well as those recently raised from seed direct from the American continent, are of a rich dark green colour, having straight clean stems, while the majority of those raised from British ripened seeds have their leaves somewhat shortened, and of a yellowish green tint, and in some cases variegated, having bare undulated stems, with branches more or less covered with resinous warts; notwithstanding that many of them had reached the age of

* A few of these have as yet been found only in one or two localities in New Zealand, *e. g.*, *Celmisia Lindsayi*, which has as yet been collected only by myself, and in the station in which I gathered it—Shaw's Bay, near the mouth of the Clutha—(the habitat also of *Ligusticum intermedium*).

from fourteen to fifteen years. The soil of the Botanic Garden is naturally of a light sandy description, and it may seem curious that the trees of the Douglas pine of foreign introduction should do so well, while the British seedlings should in so many instances dwine away.

In several counties in Scotland we are informed that fine trees of the Douglas pine are to be seen reared from home-saved seed. Soil, in connection with a more vigorous state of health of the seed-producing trees, may account for the present apparent luxuriance of the offspring. In several instances it has been found that specimen trees (not the original ones introduced by Douglas) are set down as British seedlings, and said to be as vigorous in growth as trees raised from imported seeds. Those who state this are probably not aware that, previous to British seedlings being produced, the Douglas pine was extensively propagated by layers and cuttings, and those layers and cuttings must now be noble trees. After British seedlings came to be produced freely, no more plants from cuttings or layers were ever heard of. If a degeneracy exists, as I firmly believe it does, particularly with the early seedlings of the first introduced trees, it would be well for cultivators to return to the original method of propagation by layers and cuttings, instead of trusting so much to home-saved seed. Several of those trees which produce cones freely are often stunted, and at a comparatively early age, yield abundance of cones. It is universally acknowledged that in the case of the Scotch fir and larch, the healthiest seedlings are those produced by large vigorous trees, which produce but few cones; and that stunted trees, which often produce cones in great profusion, give rise to an unhealthy offspring. Such must also have been the case with some of the original Douglas pines, which had been placed in situations not altogether suitable for them, and which at an early age have become weak. The result is that cones are freely produced; but the offspring, if any, cannot be relied upon. Plants, three or four years old, raised from home-saved seeds of the Douglas pine, as well as those of the Scotch fir and larch, look as healthy as those young plants of the same age raised from imported seeds. The constitutional weakness in the plants raised from British-saved seeds does not show at once, but

at various periods between three to fifteen years after germination. Seeds of the Douglas pine are now being sent home freely, and ought to be eagerly sought after by cultivators. It does not always happen that foreign seeds will produce healthy vigorous trees. Some of those originally sent home by Douglas produced trees which do not assume the gigantic growth nor yet have the fine green tints of vigorous trees. One variety, which was called the *Abies Douglasii taxifolia*, is of a yellowish green colour, with branches somewhat pendulous, having the stem and branches thickly covered with resinous warts. Although this tree is diminutive when compared with most of those introduced by Douglas, still it has an amount of vigour very different from many of the seedlings raised from British-saved seed. We have in the Botanic Garden one of these pendulous trees, reared from a cutting from one of Douglas's original seedlings, and known to be an inferior variety, standing side by side with the green upright form, proving in this instance that soil has not so much to do with the change as original constitutional weakness.

I also lay before the meeting specimens taken from twelve seedling plants of *Abies Menziesii*, being part of the offspring of the noble tree now growing in the Keillour Muir Pinetum, Perthshire, the property of William Thomson, Esq., of Balgowan, and which is without exception one of the healthiest and finest trees of the kind in Europe. It was planted by the late Mr Thomas Bishop, forester, Methven, about the year 1831. The tree grows in a deep, spongy peat soil, where it tillers freely, and cuttings stuck into the peat soon take root. The plants produced are very various, as seen by the specimens now exhibited. These young plants were raised from seed presented to the Botanic Garden by Mr Thomson during the year 1858, being from the first cones produced by the tree, and it may have happened that the male flowers were not perfected simultaneously with the female ones. In the neighbourhood, various species of the Abies tribe exist in large quantities, particularly the *Abies nigra*, *A. alba*, *A. rubra*, and *A. excelsa*. As some of them stand within 50 yards of the *Abies Menziesii*, judging from the diversity of seedlings, I am inclined to think that some of the young female cones must have been fertil-

ised with the pollen of some of the above-mentioned trees, particularly with that of the *Abies nigra;* as it is a remarkable fact that the nearer the seedlings approach to the *Abies nigra* the more healthy and compact they are. I also lay before you some specimens of *Abies Menziesii*, raised from home-saved seed just received from Balgowan. Notwithstanding that the seedlings were produced at a subsequent date, they exhibit much the same appearance as those raised in the Botanic Garden. Although healthy, none of them possess the vigour of one specimen which accompanies them, said to be taken from a young tree struck from a cutting eight years ago. I have also to lay before the meeting specimens of *Picea nobilis*, raised from British-saved seed. The seedlings vary much, but none of them possess the vigour of foliage as exhibited by the large tree now growing in the Botanic Garden, raised from seed originally sent home by Mr Douglas, or even the plants reared from layers and cuttings taken from the original trees. The British seedlings look well till they get about one foot high, at which size they begin to assume a yellowish tint, and finally decay. Many of the seedlings are now dead, the largest having attained the height of three feet. These circumstances prove that early decay is not altogether depending on soil, as layers and cuttings from the original imported seedlings are as healthy as the original trees. Precisely the same remarks apply to the British seedlings of the *Pinus monticola*—all assuming a yellowish tint after they reach four or five years of age. These remarks may not be applicable to British seedlings planted in a peaty soil, where the *monticola* seems to grow best. Such, however, is the case with the plants raised from home-ripened seeds now growing in the Botanic Garden, but not with those from imported seed. It may be said that layers and cuttings of coniferous trees, particularly of the Picea and Abies tribes, are not so very easily produced. With layers I would recommend the twisting of a small piece of very fine copper wire round the branch sufficiently tight to compress the bark without bruising it, previous to being pegged into the soil. When so treated the majority of them will be found rooted twelve or eighteen months after being laid, according to the nature of the wood. Young points

not more than two years old should be used. Cuttings take a much longer time. They have been successfully rooted under hand-glasses at the base of a north exposed wall, where no sun can reach them ; also in pots well drained and filled with sand and placed in a cold frame.

Professor Balfour called attention to the recent observations of Mohl and others relative to the self-fertilisation of the flowers of Oxalis, Viola, Specularia, Impatiens, Fumaria, &c. In these cases fertilisation takes place in the flower-bud. The flowers remain small and closed, and the ovary is fertilised in this condition. In some of these cases the petals are not developed, and are so minute as scarcely to be recognised. The first indications of the floral functions having been accomplished is in the appearance of the impregnated ovary. In these closed flowers the pollen grains send out tubes without contact with the stigma.

Mr Gorrie stated that he had often observed these conditions of the flowers in Impatiens, and Mr M'Nab had done the same in the case of some species of Viola.

Professor Balfour stated that he had received from Dr W. H. Campbell of Demerara, a notice of the labours of Appun, a botanist who had been sent by the colony to visit the country in the neighbourhood of the Pacaraima and Roraima Mountains, and who had made valuable collections of plants in districts hitherto unexplored. The general results of his labours were given in an address by the Hon. W. Walker, a copy of which was transmitted by Dr Campbell.

Mr M'Nab reported, that, owing to the unusual mild weather, a large number of plants continued to bloom throughout the autumn and winter months, particularly the various species and varieties of *Helleborus*, *Primula vulgaris* and *elatior*, *Gentiana acaulis*, *Arabis albida*, *Phlox verna*, *Iris tenax*, &c. &c. The only true spring-flowering plants now in bloom are the *Galanthus nivalis*, which first showed its flowers on the 2d February, *Eranthis hyemalis*, on the 5th February, and *Crocus susianus*, on the 8th February.

Mr Sadler stated that he had collected *Eranthis hyemalis* in full bloom on the 14th of January last, at Pitcaithly House, near Bridge of Earn.

Dr J. B. Wood transmitted a notice to the effect that Professor Schimper was about to publish some fasciculi of mosses, containing 220 species not met with in the British Flora, or only very rarely, and such as, if found, have only been met with hitherto in a barren state. The price of each collection is 100 francs.

Mrs Bain, Hillside, Montrose, sent specimens of a small-flowered and small-leaved variety of the white water-lily (*Nymphæa alba*). She states that it occurs in the greatest profusion in Lochalsh, the waters being entirely covered with it. It is exceedingly beautiful and delicate, and quite different from the normal form.

Mr Kerr exhibited a photograph of a cluster of 50 pears on a branch 8 inches long, and weighing 19 lbs. The pears were raised in Briggs' Orchard, Marysville, California.

Colonel Playfair, British Residency, Zanzibar, sent the fruit of a palm called " Moailie," found in the Pangani River, East Coast of Africa. It has no arborescent stem. The leaves spring out of the ground, and are of immense length. The petioles make rafters upwards of 30 feet long. The fruit is produced in clusters of more than 100.

The Right Hon. the Lord Provost (Lawson) presented specimens of *Schinus Molle*, collected by himself in Sardinia, where it grows abundantly.

Dr Balfour called attention to the Exposition Universelle d'Horticulture, which is to take place at Amsterdam in April 1865.

9th March 1865.—Dr Alexander Dickson, President, in the Chair.

The following Gentlemen were duly elected Members:—

As a Resident Fellow.
Thomas Robson, Esq.

As a Non-Resident Fellow.
John Stewart, Esq., Nateby Hall.

The following Donations to the Library were laid on the table:—

The Journal of the Linnean Society, Vol. VIII., Nos. 30, 31, 32, Botany.—From the Society.

Transactions of the Scottish Arboricultural Society, Vol. III., Parts II., III.—From the Society.

Proceedings of the Royal Horticultural Society, Vol. V., No. 2. —From the Society.

Report on the formation of the Canterbury Plains; and Report on the Geological Survey of the Province of Canterbury. By Julius Haast, Ph.D., &c.—From the Author.

Catalogue of Seeds collected in the Botanical Gardens, Calcutta, in 1864.—From Dr Thomas Anderson.

A few Notes on the Fecundation of Orchids and their Morphology, by Dr H. Crüger.—From Charles Darwin, Esq.

The following additions to the University Herbarium were announced:—

From Dr Thomas Anderson, Calcutta—Large collection of Plants from India.

From Dr R. Spruce—350 Species of Plants collected by him in the Andes and other parts of South America.

From Mrs Ross of Pitcalnie—Specimens of *Hierochloe borealis*, collected near Thurso.

The following Communications were read:—

I. *Notice of Rare Plants collected in the South-West of England.* By F. NAYLOR, Esq.

Mr Naylor read notes, illustrated by a series of specimens, on some of the rarer and the local plants collected last autumn, in company with Mr C. P. Nicolson, during an excursion in the south and south-west of England. The following is the list of some of the plants collected, with their localities:—

SOUTH DEVON.—*Thalictrum saxatile* (DC.), Berry Head; *Helianthemum polifolium* (Pers.), Cliffs at Torquay; *Viola lactea* (Sm.), Axminster; *Hypericum undulatum* (Schousb.), the *H. bœticum* of Boiss., boggy ground near Common Wood, Bickleigh, the station at which this interesting addition to the British flora was discovered in August 1863 by Mr T. A. Briggs (Mr Naylor again met with this form near Helston, Cornwall, a station in which it had attracted the attention of Mr Cumrock of that place some time previously, without his being able to identify it. The fact is thus established of its having a wider range than has been

supposed); *Rubus saxatilis* (L.), Bickleigh; *Epilobium lanceolatum* (Seb.), Plymouth; *Daucus gummifer* (Lam.), Whitsand Bay; *Eryngium campestre* (L.), Stonehouse; *Linosyris vulgaris* (Cass.), Berry Head; *Lobelia urens* (L.), Kilmington Common, Axminster, its only known British station, first recorded by Hudson (second edition, 1778); *Linaria supina* (Desf.), Plymouth, on débris at the limestone quarries, Catt Down; *Orobanche amethystea* (Thuil), Whitsand Bay, parasitic on *Daucus gummifer; Melittis Melissophyllum* (L.), Bickleigh: *Lastrea Fœnisecii* (Wats.), Bickleigh.

Cornwall.—*Trifolium Bocconi* (Savi), Cadgwith; *Trifolium Molinierii* (Balb.), Lizard; *Genista pilosa* (L.), Kynance; *G. tinctoria*, v. *humifusa*, Halzapheron Cliffs; *Cotyledon Umbilicus* (L.); *Herniaria ciliata* (Bab.), Lizard; *Corrigiola littoralis* (L.), Loe Pool, Helston; *Illecebrum verticillatum* (L.), near Falmouth; *Physospermum cornubiense* (DC.), Bodmin; *Erica ciliaris* (L.), Carclew; *Erica vagans* (L.), Lizard, abundant throughout the district; *Eufragia viscosa* (Benth.); *Sibthorpia europœa* (L.), Bodmin; *Orobanche rubra* (Sm.), Lizard; *Allium Babingtonii* (Borr.), Poltesco; *Allium Schœnoprasum*, v. *sibiricum* (L.), Rill Head; *Asparagus officinalis* (L.), Cadgwith; *Scilla autumnalis* (L.), cliffs near Lizard; *S. verna* (Huds.) cliffs, Lizard and Land's End (in fruit); *Cyperus longus* (L.), Poltesco; *Scirpus triqueter* (L.), banks of Tamar, near Calstock; *Agrostis setacea* (Curt.), Helston; *Briza minor* (L.); *Gastridium lendigerum* (Gaud), Lizard; *Cynodon Dactylon* (Pers.), Mount's Bay; *Asplenium lanceolatum* (Huds.), Bodmin.

Lyme Regis.—*Vicia bithynica* (L.); *Erythrœa pulchella* (Fries).

Cheddar and neighbourhood.—*Dianthus cæsius* (Sm.), cliffs; *Thalictrum saxatile* (Schleich), cliffs; *Sedum rupestre* (L.), cliffs; *Polypodium calcareum* (Sm.), cliffs; *Campanula Trachelium* (L.); *Petroselinum sativum* (Hoffm.); *Tordylium maximum* (L.), Wells Road, a single specimen; *Saponaria officinalis* (L.), Wells; *Ceterach officinarum* (Willd.), Westbury, abundant.

Southampton and Isle of Wight.—*Pyrus torminalis* (Sm.), Carisbrook, I. W.; *Petroselinum segetum* (Koch),

Southampton; *Specularia hybrida* (DC.), Hursley; *Pulmonaria angustifolia* (L.), Quarr Abbey, I. W.; *Atropa Belladonna* (L.), Netley; *Lycium barbarum* (L.), near Rhyde, naturalised; *Linaria repens* (Ait.), Chandlersford; *L. Sepium* (Allm.), Chandlersford, with *L. repens* and *L. vulgaris; L. speciosa* (Bromf.), near Portsmouth; *Calamintha sylvatica* (Bromf.), Apes Downs, I. W.; *Galeopsis Ladanum*, v. *canescens* (Schul.), Southampton; *Polygonatum multiflorum* (All.), Netley; *Acorus Calamus* (L.), Winchester; *Spartina alterniflora* (Lois), mud-flats on Itchen, Southampton. On a former visit (1862) to the island, Mr Naylor collected *Papaver hybridum* (L.), Undercliff, I. W.; *Matthiola incana* (Br.), Freshwater; *Vicia gracilis* (Lois), Bembridge; *Lepigonum rupestre* (Kindb.), Luccombe; *Bupleurum tenuissimum* (L.), Bembridge; *Erythræa littoralis* (Fr.), Alum Bay; *Melampyrum arvense* (L.), Undercliff; *Spartina stricta* (Roth), Yarmouth; and *Lastrea Thelypteris* (Presl), Freshwater Gate.

The following Shoreham and Surrey plants close the list:—*Trifolium stellatum* (L.), Shoreham; *Geranium Robertianum*, v. *purpureum*, Shoreham; *Suæda fruticosa* (Forsk.), Shoreham; *Buxus sempervirens* (L.), Box Hill; *Cuscuta Trifolii* (Bab.), Shere, not before recorded in that locality; *Phyteuma orbiculare* (L.), Dorking; *Impatiens fulva* (Nutt.), Albury; *Cephalanthera grandiflora* (Bab.), Shere.

II. *Notice of Esparto.* By the Right Hon. the Lord Provost (Charles Lawson, Esq.)

The Lord Provost communicated the following letter from Mr Hardy Hislop, of Lisbon:—"I have made the inquiry you wished relative to the 'Esparto,' and find there are thousands of tons annually shipped from Alicante and Carthagena. In Alicante I found three large vessels loading the goods for England, and discovered that last year 4000 tons were shipped to the following countries:—England, France, Belgium, and Sweden. Its use is for the manufacture of paper. The fibres are used in the Scotch carpet trade, Kidderminster, and Brussels. The grass is grown in a dry soil. It is not grown from seed; when

planted it spreads rapidly. It is not cut, but torn up by the roots—a very easy process when ripe. The fibre makes a paper with a fine surface, and strong. A process is employed for extracting the glue-like matter in it, leaving the fibre clean and fit for use after drying." The Lord Provost suggested that the plant might perhaps be cultivated in some of the milder parts of this country.

Dr Balfour remarked that the plant was *Macrochloa tenacissima*, and grew on sandy shores like bent. The common name of the grass is derived from the Latin *Spartum*, the appellation given to a plant from which the ancients made bands to tie vines, and ropes for ships. In some of the Latin dictionaries it is said to be a kind of broom, but this is a mistake. The old botanical name of broom, *Spartium*, seems to be derived from this.

In Livy we find an allusion to Spart, as used for ships.*

In Greek, the word σπαρτον is applied to *funiculus sparteus.*†

Specimens of Spart in various states were exhibited.

III. *Note on the discovery of* Neotinea intacta (*Reich.*) *in Ireland.* By A. G. More, Esq., F.L.S.

Mr More remarks: My sister and myself first noticed *Neotinea intacta* early in the month of April (1864). It attracted our attention as appearing above ground at a singularly early date, in a locality where we knew that *Orchis mascula* was the only early orchis, and *Orchis mascula* of course it could not be.

My sister following up this clue after I had left Castle Taylor, collected and dried several specimens, remarking that the little orchis was something she had never seen before. After a great deal of trouble, my friend Dr Moore discovered its name, which was soon confirmed by Reichenbach himself; and we thus had the great pleasure of adding one more to the list of southern plants which grow in Ireland without reaching Britain proper. It is hard to say

* Livy says—" Vis magna Sparti ad rem nauticam congesta ab Asdrubale" —xxii. 20.

† Thus, in the Iliad, we meet with. Καὶ δὴ δοῦρα σέσηπε νεῶν, καὶ σπάρτα λέλυνται—ii. 135.

with which group the Neotinea should be associated. It is not so peculiarly western as *Erica mediterranea*, *Dabœcia polifolia*, *Pinguicula grandiflora*, and the Spanish Saxifrages. It may perhaps better be classed with *Arbutus Unedo*; yet it is to be remembered that, in Ireland, it does not occupy quite the same position. Castle Taylor is situated about six miles inland from the Bay of Galway, on a part of the "flag" limestone district, whose flora is best known from that of "Burren" in Clare.

Those botanists who are interested in the subject will find an excellent account of the Burren Flora, published in the "Transactions of the Royal Irish Academy," vol. xxiv. (1862), by my friend, Mr F. J. Foot, who has thoroughly investigated this interesting limestone tract in the county of Clare. Some remarks of my own, on the *Flora* of Castle Taylor, Galway, are published in the "Proceedings" of this Society for the year 1855.

It is remarkable that in the very same field with *Neotinea intacta* occurs a very distinct species of Hawk-moth *Anthrocera minos*, which, in the British Isles, occurs only in the Burren district; and from this circumstance I had always expected to find some peculiar plant also. *Arbutus Unedo* at Killarney is similarly associated with two remarkable and local species of insects, *Notodonta bicolora* and *Hydrelia Bankiana*. A mollusk, *Geomalacus maculosus*, is also peculiar to the Killarney district.

Judging from the similarity of the *Flora* throughout the district, and from the range of the *Anthrocera minos*, which extends to Burren, I should anticipate that *Neotinea intacta* may be discovered in other localities on the same limestone; but it must be looked for early in the season, about the beginning or middle of May.

In a late number of Seemann's "Journal of Botany,"* Dr Reichenbach has given a valuable commentary on the synonymy, range, and peculiarities of this remarkable plant.

Dr White stated that *Anthrocera minos* had also been recorded as having been found in Argyleshire and Kincardineshire, but there is reason to fear that a variety of *A. Filipendulæ* has been mistaken for it in Scotland.

* No. 25, January 1865, vol. iii. p. 1.

IV. *Summary of some of the more interesting Botanical Papers published in France since July* 1864. By G. M. Lowe, Esq.

The following is a brief summary of the more interesting botanical papers published in the French language since July 1, 1864.

In this retrospect I have confined myself chiefly to anatomical and physiological papers.

Prominent in interest amongst these papers stands that of M. Boussingault, entitled "Vegetation in Darkness," in which he shows that in darkness a plant loses its carbon just as the embryonic vegetable and roots do under similar conditions—the carbon being consumed by the oxygen inhaled and carbonic acid given off. Thus a plant is under the power of two antagonistic forces, the one tending to abstract, the other to supply matter; and, according as either of these forces predominate, the *weight* of the plant increases or diminishes. Following up this relation, it becomes evident that the result is determined by the intensity of light and temperature.

The paper is illustrated by a number of tables, the results of the author's experiments. They clearly prove that a plant developed in the dark borrows all the principles of its organism from the seed from which it springs; the atmosphere acting only as a consuming agent. Carbonic acid is incessantly emitted so long as the matters contained in the seed supply carbon, which amounts to saying that the duration of the existence of a plant deprived of light depends on the weight of these matters.

A plant growing in darkness, then, comports itself in many respects like certain animals of the lower types, such as zoophytes, which possess no special respiratory organs, combustion going on in the cellular tissue instead, through the medium of water. The plant subsists by consuming sugar, albumen, fatty matters, and phosphates, elaborated in the perisperm or cotyledons; and when, by exhaustion, these contained matters become insufficient, it languishes and dies of inanition.

Further, an animal of the most simple organisation does

not only emit by respiration, heat, water, and carbonic acid; but a part of the albumen which is consumed is modified by respiratory combustion into a crystalline nitrogenous compound, *urea*, which is met with in the excretions. In the respiratory combustion of a plant living in the dark, a similar modification of albumen cannot be so manifested, because vegetables do not possess excretory organs; but in the juices filling the cells there is found an immediate crystalline compound, *Asparagin*, which is an amide like urea, and transforms itself as easily into aspartite of ammonia as urea does into carbonate of ammonia.

To prove that asparagin is certainly formed during cellular combustion—for at first the seeds do not contain the least trace of it—the author subjoins the following experiment:—

"On the 6th of July I placed in pumice-stone, washed and calcined to cleanse out all organic matter, 246 seeds of the kidney bean, weighing 261 grammes.* These were placed in a dark chamber, and kept moistened with distilled water, free from ammonia. On the 25th of July 5·40 grammes of crystallised asparagin were obtained from the plants."

The next paper is extracted from the "Transactions of the Society of Sciences, Agriculture, and Arts of Lille." The subject is "Chemical Researches on Vegetation," by M. Coremoinder. The author commences by narrating the irritable and angry discussion which took place between Ingenhousz and Senebier towards the end of last century. The former was the first to show that "the leaves of plants exposed to darkness continually expire a mephitical gas, injurious to animal respiration." This announcement was strongly opposed by Senebier, who accused Ingenhousz of imposture and impiety. The following singular objection is worthy of mention:—"It is through want of observation," said he, "that nature and plants are so calumniated, by attributing to them the dangerous property of giving out, during the night, an air calculated to diminish the purity of the atmosphere by its noxious qualities. Nature avenges herself by facts which she makes us see, and ever

* 1 gramme = 15·43235 grains.

proves to us that the number of her beneficent relations increase the more deeply we investigate her sublime processes."

When the nature of the mephitical gas exhaled by leaves in darkness was discovered, the dispute raised between Ingenhousz and Senebier subsided, since carbonic acid, the gas in question, has such characteristic properties, that experiment soon decided in favour of Ingenhousz, the author of this important discovery. In his work, entitled "Experiments on Plants," he established, in a special chapter, that "plants exhale a noxious gas during the night, and in dark places during the day, contaminating the air by which they are surrounded; but this bad effect is more than compensated by their salutary influence during the day." The correctness of the latter statement was fully proved by M. Coremoinder in 1858.

The present paper is a long one, and contains in detail an account of the author's experiments. The following are the results:—

1. Plants possess the property of exhaling carbonic acid during the night, and in artificial darkness during the day.
2. Buds and young shoots, whose leaves are still unexpanded, expire carbonic acid during the day, both in the shade and full glare of the sun.
3. Adult leaves exposed to the sun do not expire carbonic acid, inasmuch as they then possess the property of decomposing the acid, of assimilating the carbon, and exhaling the oxygen. The same amount is exhaled under a cloudy sky as on the finest day; but when transferred to a room lighted only by lateral windows, then they cease to disengage it in more or less appreciable proportions, if not exposed to the direct rays of the sun.

In the "Annales des Sciences Naturelles" is a translation of the first part of a very lengthy paper by Hugo von Mohl, entitled "Some Observations on Dimorphous Flowers," an account of which I hope to lay before you at some future period.

An interesting communication is published in the "Comptes Rendus," by M. Chatin, on "The Anatomy of

the Balanophoraceæ, considered as regards the characters which they present for classification." The Balanophoraceæ, he says, constitute with Cytinaceæ and Rafflesiaceæ a singular class of parasitic plants, designated by the name of Rhizanths, whose flowers, sometimes small and clustered, at others large and solitary, seem to possess, like the mushrooms, a sort of underground spawn. From their anatomy, the author is inclined to raise the Rhizanths from their position between the Phanerogams and Cryptogams, and place them high in the vegetable scale, between the Mono- and Di-cotyledons; and he assigns them this position, 1*st*, because of their structure proper; and, 2*d*, on account of the affinities which they possess with other orders; but more especially from the structure of the stamens and ovules.

M. Jodin has shown that the chemical action of light on chorophyll depends on the presence or absence of the influence of life. Thus life and light, acting together on a vegetable organism, manifest their chemical action by the decomposition of carbonic acid, and the plant becomes green by the production of chlorophyll. Life alone without light is only manifested by the phenomenon of combustion; the plant is blanched. Lastly, light alone, without life, only produces the phenomenon of oxidation; plant tissue, deprived of life, is discoloured by light; chlorophyll is destroyed.

The following facts are deduced from M. Godron's work on the Inflorescence of Cruciferæ:—Bracts are generally awanting in the racemes of Cruciferæ. In some of the characteristic species we find bracts occasionally in the lower flowers. In *Sisymbrium supinum* (L.), all the flowers are produced with a pinnatifid bracteal leaf, and the same is the case with *Sisymbrium hirsutum* (Lagasc.) *Brassica oleracea* has been seen with large oblong bracts in connection with its lower flowers, while smaller bractlets occurred at the upper part of the raceme. Similar phenomena have been observed in *Erysimum cheiriflorum* (Wallr.), *Arabis turrita* (L.), *Hesperis matronalis* (L.), *Bunias orientalis* (L.) Sometimes the lower and middle part of the inner face of the bract become united to the base of the peduncle. This has been noticed

in *Iberis sempervirens* (L.), and in other cruciferous plants. Sometimes when the bracts are completely wanting, there are traces of the decurrence of leaves at the base of the naked peduncle.

Godron says that—1*st*, The quaternary type, with two rows of stamens, is the normal condition of Cruciferæ ; 2*d*, That the absence of bracts and the greater or less flattening of the peduncle, the more or less depressed form of the flower-bud, the slight irregularity of the calyx, the absence of two stamens in the outer verticil of the andrœcium, and often of the two glands on which they rest, and, finally, the abortion of two carpellary leaves, are determined by a pressure which is exercised from within outwardly on the flowers of Cruciferæ ; 3*d*, This pressure is owing to the accumulation of flowers which are developed in great numbers at the summit of the inflorescence in its corymbiform state, and which are naturally restrained or hindered in their evolution ; as well as to the resistance which is presented to this expansion by the accumulated leaves which surround the inflorescence at its origin.

On examining the flowers of Fumariaceæ in their early development, M. Godron finds them quite regular, but flattened from before backwards, as if they were compressed between the axis of inflorescence and the bract. They preserved this regularity in Diclytra, Adlumia, and Dactylicapnos. In these three genera, the two external petals, placed laterally, undergo during development an important modification. The base of each is prolonged into a short and rounded spur, and the two nectariferous appendages become finally quite regular. The two sepals placed superior and inferior also remain perfectly regular. Again, in the genera Fumaria and Corydalis only one spur is developed, so as to render the flower irregular. This spurred petal becomes larger than its antagonist.

M. Godron has examined *Corydalis solida* (Sm.), and *C. cava* (Schweigg), in their early condition, while still under ground. He traces the abortion of one of the spurs in the petals to the flowers during their development being compressed at the base on one side only. In this way development of the nectary and its appendages is prevented. M. Godron made experiments with the flowers of Diclytra, so

as to compress one of the petals at the base during its development, and he thus rendered it like Fumaria, with a single spurred petal. In Diclytra and Adlumia the spurs develop at a later period than in Fumaria, and in such a way that the raceme, in elongating, separates the flowers from each other, and allows the free and equal formation of spurs. The regular form sometimes continues in the Fumaria and Corydalis. M. Godron has seen *Corydalis solida* assuming a pelorian form, by two or even four petals becoming spurred or calcarate. The flowers in this case become sterile.

M. Lemaine has demonstrated by experiment that the spores of *Achorion Schœnleinii* are capable of reproducing the skin disease called *favus* through the medium of the air. This fact had long been suspected by M. Bazin, physician to the hospital of St Louis, but it had never been demonstrated.

A paper was read before the Academy of Sciences of France in July, by M. Heht, on the Chemistry of *Cotyledon Umbilicus*—a plant which has been used as a remedy in epilepsy—showing the presence of Trimethylamin, in the form of a chloroplatinate, along with a certain amount of ammonia and nitrate of potash. The author says—" The presence of this tertiary monomine in *Cotyledon Umbilicus*, concurrently with ammonia and an appreciable quantity of nitre, shows that this plant is not inert, as was for a long time supposed, but contains active substances capable of modifying organic tissues."

[I have noticed this paper on account of the conflicting opinions regarding the efficacy of *Cotyledon Umbilicus* in epilepsy ; in Ireland, where the plant may be said to abound, it has been used with good effect by many practitioners. It was first used and brought into general notice by Dr Salter of Poole, and afterwards by the late Dr Graves, who considered it a valuable remedy in a disease " so whimsical in its amenability to treatment." (*Dublin Quarterly Journal of Medical Science*, vol. xiv. p. 257.) Nevertheless it has been deemed unworthy of a place in the " British Pharmacopœia." In modern times it has not been tried in

any other spasmodic disease than epilepsy; but in the seventeenth century we find it was in great repute as a deobstruent and antiscorbutic.]

The last paper is one by Gaston de Saporta, "On the Catalogue of Plants having deciduous leaves, in the Gypsum d'Aix." The list of vegetables having caducous leaves, he says, congenerous with those of modern Europe, in the tertiary flora of a bygone age, is one of the most singular questions, which has raised up once more a new study of fossil plants in modern times. The very existence even of these vegetables, or rather the contrast which results from their association with complete tropical forms, constitutes in itself a very remarkable phenomenon. It has been vainly endeavoured to explain it by causes analogous to those at present existing. It is true that the supposition of an alpine region, situated in the neighbourhood of ancient deposits, sufficiently elevated and cold to account for the presence of these species, immediately presents itself to the mind as a natural hypothesis; and meanwhile, when we reflect that it is not only upon an isolated point, but in a constant manner, and in all the flora, commencing at the upper Eocene, that European forms are met with,—limited in number, it is true, but with a remarkable fixity,—it is then we are obliged to see in them not the result of an accident of locality, but one of the elements of vegetation at that time, an element which must be taken into account if we would analyse everything on which it depends. The regular development of this element itself, by very slow degrees, constitutes the most salient trait in tertiary vegetation in its march towards modern times.

Among the fossil plants may be noticed the following:—*Betula gypsicola*, *Ulmus plurinervia*, *Populus Heerii*, *Ribes Celtorum*, *Acer ampelophyllum*, *Paliurus tenuifolius*, *Cratægus nobilis*, *Cercis antiqua*.

Considering all the indications, it is probable that the plants having deciduous leaves in the Flora of Aix were of a very limited number, and that their impressions are very rare in the beds formed at that epoch, their station little removed outside the perimeter of ancient shores, their distribution in isolated individuals, and the mediocral size of most of

them, having concurred to produce this result. Lastly, the periodical fall of leaves among these species, far from arguing the existence of a cold season, is a phenomenon very reconcilable with the elevated temperature which justifies the profusion of tropical forms in the flora of the Gypsum d'Aix.

V. *Report on Vegetation in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

The long duration of the recent snowstorm has greatly retarded the flowering of many plants which, previous to last year, 1864, were usually recorded as being in bloom long before this time. The plants now in flower (with the exception of *Nordmannia cordifolia*) are exactly the same as those recorded in flower on the 10th of March last year. These are *Helleborus abschasicus*, *H. olympicus*, *H. purpurascens*, *H. niger*, *Galanthus nivalis*, *G. plicatus*, *Leucojum vernum*, *Eranthis hyemalis*, *Erica herbacea*, *Primula vulgaris*, *P. elatior* var., *Corylus Avellana*, *Petasites nivea*, *Gentiana acaulis*, *Sisyrinchium grandiflorum*, *Crocus susianus*, *C. vernus*, and *Hepatica triloba.*

The date of flowering of those plants usually recorded, but not enumerated as being in bloom at the February meeting of the Society, are :—

Corylus Avellana,	Feb. 18	Crocus vernus,	Feb. 24
Erica herbacea,	„ 23	Leucojum vernum,	„ 26
Arabis albida,	„ 23	Petasites nivea,	„ 26
Hepatica triloba,	„ 23	Sisyrinchium grandiflorum	„ 28
Galanthus plicatus,	„ 23		

A remarkable feature in the flowering of certain plants this year, was the progress made by some of them under the snow. Immediately after the snow disappeared the snowdrops were found to be two inches high, and in full bloom, on banks where no appearance of them was observable previous to being covered up. A bed of *Eranthis hyemalis* (winter aconite) had about eighteen or twenty blooms open previous to being covered with the snow; the day the snow disappeared the bed was found to be in full bloom, having been covered up for nearly a fortnight by the

last snowstorm. The *Erica herbacea*, *Arabis albida*, *Galanthus plicatus*, and *Hepatica triloba*, were also in bloom when the snow melted.

Lowest temperatures indicated during the nights from 10th February till 9th March 1865:—

Feb.	10	19° F.	Feb.	24	38° F.
„	11	30	„	25	35
„	12	31	„	26	38
„	13	28	„	27	28
„	14	32	„	28	31
„	15	18	March	1	34
„	16	27	„	2	39
„	17	15	„	3	29
„	18	19	„	4	32
„	19	29	„	5	33
„	20	26	„	6	32
„	21	25	„	7	33
„	22	32	„	8	27
„	23	44	„	9	28

Mr Sadler exhibited fourteen species of plants in full flower, which had been transmitted by Miss Drummond, Pitcaithly House, Bridge of Earn. They had been plucked in the open air on Tuesday 7th March.

Letters were read from Mr John Sim, Perth, as to the mode of growth in the rhizome of *Circæa alpina*, and on the transmutation of species.

A letter was read from Mr William Robson, who was sent out from the Edinburgh Botanic Garden to India, dated Sukvar Darjeeling, 8th January 1865. He visited Ceylon, and procured cinchona plants for the Botanic Garden at Peradenia, near Kandy. Mr M'Nicoll has cultivated the plant there successfully from cuttings. He visited the gardens at Ootacoomund, on the Neilgherries, under the superintendence of Mr M'Ivor, who is cultivating cinchona very extensively. Orders have been given to him to plant 130 acres yearly. Mr Robson saw the cinchona plantations; some of the specimens, which had been planted two years previously, were five feet high. He describes the climate as being remarkably fine, and suited to the cultivation of all sorts of vegetables and flowers. Mr Robson got additional cinchona plants there, which he conveyed to

Calcutta along with those from Ceylon. He gave a description of the sad havoc made in the Botanic Garden at Calcutta by the hurricane. He left Calcutta on 1st December last, and reached Sukvar on the 21st. This place is situated about five or six miles from Darjeeling, and about 2000 feet lower. The country is very beautiful, and the climate excellent. There are upwards of 900 acres of tea cultivation at the place, and some plantations of cinchona. The establishment to which Mr Robson belongs supply their servants with good houses. The head manager receives 1000 rupees per mensem, the assistants 100, and he receives 125.

A letter was read from Dr John Anderson, dated "Calcutta, 23d December 1864," in which he says:—"There are many encouragements for gardeners to come out here. Their outfit and passage-money are paid; and after fifteen years' service they are entitled to a third of their pay, calculated on the rate of the last five years of service, as pension. John Scott (from the Edinburgh Botanic Garden) arrived here on the 21st, and my brother at once appointed him head gardener at Darjeeling. He is to be in charge of the cinchona cultivation, and leaves this for Darjeeling in three days.

"I am to be appointed for two months to make observations on the age of timber. The materials for such an investigation afforded by the late cyclone are immense; and as the ages of a great many of the destroyed trees are on record, we hope to be able to arrive at some definite conclusions as to the value of concentric rings in a country like India, as an index of the approximate age of various species. I have been to Darjeeling, and can assure you no words can convey the faintest conception of the magnificence of the snow range as seen from that station. When I first saw the snow, I felt it worth coming from Europe to see, and I still feel the same after having become familiarised with it, and looking on it for a month. Everything is on such a grand scale at Darjeeling,—except the houses,—that it takes some time before the eye becomes accustomed to the great heights and distances, and to the great depths of the splendid valleys. The cinchona cultivation is progressing capitally. There are 15,000 plants in the open air. Had I not com-

menced this note at the eleventh hour, I would have liked to have told you something of the damage done to this garden by the cyclone. All the finest trees are destroyed, 950 being uprooted. 2000 trees in all were destroyed, and now the garden is entirely without shade. Formerly, there were splendid avenues of teak, mahogany, and casuarinas, but now they are entirely gone. It is one of the most painful sights I have witnessed."

Dr Lowe, Balgreen, sent specimens of flowers of *Hepatica triloba*, vars. *alba* and *nivalis*. One of the flowers had pink anthers, the other white. The latter dries with a pink tinge on the petals, while the former continues of a pure white.

Dr Alexander Dickson exhibited specimens of *Peziza coccinea* from Arniston woods, and a cone of *Pinus Coulteri* with the scales numbered so as to exhibit the 13-34th arrangement.

Specimens of Lepidodendron and Lepidostrobus, which have been added to the Museum at the Botanic Garden, were exhibited.

The meeting agreed that all the members should be asked to contribute their *cartes de visite* for insertion in the Society's album, now in progress of formation.

Dr Balfour stated that he had received a letter from Dr Murchison, in which he says that the scientific men in London have set agoing a subscription for a memorial to the late Dr Hugh Falconer, and that it is proposed to have a bust, and a fellowship in natural science in the University of Edinburgh. It is hoped that many friends in Edinburgh will join in the subscription.

Dr Balfour also alluded to a new work now in process of publication, entitled "Contributions towards a Cybele Hibernica; being Outlines of the Geographical Distribution of Plants in Ireland," by D. Moore, Ph.D., F.L.S., and A. G. More, F.L.S.

13th April 1865.—Dr Alexander Dickson, President, in the Chair.

The following Gentlemen were duly elected Members of the Society :—

As Resident Fellows.

Robert Traill, Esq., Aberlady Lodge.
W. R. Thomson, Esq.

As a Non-Resident Fellow.

M. C. Cooke, Esq., London.

The following Donations to the Society's Library were laid on the table :—

Manual of Botanical Terms. By M. C. Cooke.—From the Author.

Introduction to the Study of Microscopic Fungi. By M. C. Cooke.—From the Author.

A Plain and Easy Account of British Fungi. By M. C. Cooke. —From the Author.

Proceedings of the Royal Horticultural Society, Vol. V. No. 3.—From the Society.

Catalogue of Plants.—From Vilmorin-Andrieux & Co., Paris.

Nova Scotia Journal of Agriculture, No. 1.—From Professor Lawson, Halifax.

Zur Entwickelungsgeschichte des Blattes, von Dr A. W. Eichler. —From the Author.

Ueber die Ursachen des Gummiflusses bei den Kirschbaumen, von Dr A. W. Eichler.—From the Author.

Bewegung im Pflausenreiche, von Dr A. W. Eichler.—From the Author.

On the Menispermaceæ. By Dr A. W. Eichler.—From the Author.

Proceedings of the Natural History Society of Dublin, Vol. IV. Part II.—From the Society.

The following Donations to the University Herbarium were announced :—

From Professor Clos, Toulouse—Plants from the south of France.

From Henry Trimen, Esq.—Rare Plants from the New Forest, Hampshire.

From F. Naylor, Esq.—Specimen of *Hypericum undulatum*, from near Plymouth.

From T. B. Flower, Esq., Bath—Specimens of *Ononis reclinata*, collected in Jersey.

From Mr Roy, Aberdeen—Specimens of *Polytrichum sexangulare.*

From Dr Lauder Lindsay—Specimens of *Grimmia ptychophylla* (Mitten), and *Sphæria Lindsayana* (Currey), new species, from Otago, New Zealand.

The following Donations to the Museum at the Royal Botanic Garden were noticed :—

From Mr John Sang—Portion of a Palm stem cast ashore between Akergill Tower and Keiss Castle, Caithness, in 1864; also a seed of *Entada scandens.*

From Colonel Robert Maclagan—Specimens of the fruit of Luffa, from India.

The following Communications were read :—

I. *An Account of the Flora of that part of Hampshire called the New Forest.* By Henry Trimen, Esq.

The author commenced by describing the situation, boundaries, extent, geology, scenery, and physical geography of the New Forest, and then proceeded to an examination of its botany. After noticing briefly the plants recorded by various authors, and remarking on the little attention which the district had received from botanists, he stated that the number of species known to inhabit it now amounted to 723, of which number he had himself collected 530. Having divided the flora of the Forest into three groups—the plants of the heaths and moors, those of the woods, and those of the streams and water-courses—Mr Trimen enumerated the more important species in each division, and showed specimens of many of the plants he mentioned. Amongst those were specimens of *Gladiolus illyricus* (Koch), a very handsome plant, only discovered as a native of this county in the New Forest a few years ago. The author then gave a sketch of the flora of the sea-coast, and of the cultivated parts of the district, and remarked on the few species found in those localities.

The flora was then considered as a whole, and shown to

contain many species of both the east and west of England, which are not usually found in the same district. The western type of vegetation was seen to prevail, however, and this was considered to be due to the damp humid climate. Numerous species, rare in the south of England, but common in North Britain, were mentioned, and their growth traced to the barren nature of the soil. After alluding to the influence of the geological formation of the Forest on its flora, the author concluded his paper by urging collecting botanists to compile complete and accurate lists of the plants of a district, in preference to hunting for varieties.

The paper was illustrated by a map of the Forest, and by numerous dried specimens of plants.

II. *On new or rare Cryptogams from Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S. Edin., &c.*

I. Musci.

Grimmia (*Rhacomitrium*) *ptychophylla* (Mitten), nov. sp.

Botanical Diagnosis.—Cæspitosa; ramis fastigiatim ramosis, densifoliis; foliis humidis, patentibus, siccis, appressis, strictis, profunde triplicatis, lanceolatis; dimidio inferiore; medio latiore; marginibus reflexis; nervo tenui, angusto in plicæ medio abscondito; sub apice acutato, breviter hyalino, evanido; cellulis basi ad angulos 2-3 oblongis inde ad apicem omnibus elongatis angustis; parietibus pellucidis, punctulatis, crenulatisque.

Obs.—The specimens of this very distinct species consist of stems taken from a tuft, and are divided into numerous short branches, all directed upwards. The lower parts are brown; the apices of the shoots yellowish brown. The hyaline acutate apex of the leaf is not observable until the leaf has been laid out under the microscope. In size and general appearance this species resembles *Rhacomitrium protensum*, var. 3, from Kerguelen's Land, of the "Antarctic

* The following list includes genera and species which, though not new to science, are either new to Otago or New Zealand, or, from the rarity of their forms or otherwise, possess a special interest. The plants described or enumerated form part of the cryptogamic section of the Otago herbarium I formed in 1861. (*Vide* Proceedings of the Society for February 9, 1865.)

Flora ;" but it is readily distinguished from that, and all the other species yet known, in the substance and plication of its leaves, which, as seen from behind, and including the reflexed margins, appear to be 5-ribbed.*

This species was detected among the mosses of my Dunedin Herbarium by Mr Mitten ; but it occurred only as a tuft intermixed therewith. The label has been lost, and it is now impossible to say what was its precise habitat. The plant, moreover, was not in fruit, so that we have yet to learn the characters of its reproductive organs.

The following eight species do not appear hitherto to have been found in New Zealand, but they are recorded in the Muscological Papers of Mitten as natives of Tasmania :—

1. *Webera nutans* (Hedw.). Top of Kaikorai Hill, near Dunedin. Both genus and species are apparently new to New Zealand.
2. *Hypnum aristatum* (Hook. fil. and Wils.). Saddlehill Bush.
3. *H.* (*Stereodon*) *chrysogaster* (C. Müller). In the Bush, ravines of the Chain Hills.
4. *Trachyloma arcuatum* (Hedw.). Saddlehill.
5. *T.* (*Hypnum*) *comosum* (Schw.). East Taeri Bush.
6. *Leskea* (*Thuidium*) *hastata* (C. Müller). Christie's Bush, Saddlehill.
7. *Rhacopilum strumiferum* (C. Müller). Christie's Bush, Saddlehill.
8. *Cyathophorum bulbosum* (Hedw.). In the Bush, ravines of the Chain Hills.

In addition to these Tasmanian mosses, the following do not appear to have hitherto been collected in New Zealand :—

9. *Trachyloma* (*Hypnum*) *Menziesii* (Hook.). In the Bush, ravines of the Chain Hills.

The "Flora Novæ Zelandiæ" of Dr Hooker mentions only one New Zealand species of this genus—the common *T. planifolium* (Brid.), which I found growing in the same habitats with *T. Menziesii*.

10. *Isothecium clandestinum* (Hook. fil. and Wils.). In the Bush, ravines of the Chain Hills.

* For the foregoing description and remarks I am indebted to Mr Mitten. A.L.S., of Hurstpierpoint, Sussex, by whom also were determined all the Mosses and Hepaticæ mentioned in the following list.

11. *I. ramulosum* (Mitten). On dead trees: in the Bush, ravines of the Chain Hills.

12. *Pogonatum aloides* (Brid.). Occurs in my Dunedin herbarium; but the label has been lost, and its precise habitat is not therefore known. It has a wide geographical range, which includes Thibet, Ceylon, the Himalayas, and other parts of the world.

13. *Bryum chrysoneuron* (C. Müller). East Taeri Plains: ravines of the Chain Hills. Generally associated with *Didymodon* (*Ceratodon*) *purpureus* (Hedw.), a British and cosmopolite moss, which is as abundant in New Zealand as it appears to be elsewhere, and which I collected in the East Taeri Bush.

Both genus and species are apparently new to New Zealand.

There are a few species, which are recorded in the "Flora Novæ Zelandiæ" as *North* Island mosses; but which do not appear hitherto to have been collected in the *South* Island, viz.:—

1. *Dicranum* (*Campylopus*) *introflexum* (Hedw.). East Taeri Bush. Common on clayey hills in the North Island, says Dr Hooker. It is further common in Tasmania and in the southern hemisphere generally.

2. *Bryum campylothecium* (Taylor). East Taeri Bush. A native of Tasmania and Australia.

3. *Trachypus* (*Meteorium*) *flexicaulis* (Taylor). East Taeri and Saddlehill Bush. A native of Tasmania and South America.

The last-mentioned moss is distinguished by its pensile habit, fringing the branches of trees with a copious and beautiful green drapery. It is generally associated with a much more abundant or common moss of similar habit (*Meteorium molle*, Hedw.). The latter occurs throughout New Zealand, being probably one of its commonest and most familiar Bush mosses. It has, moreover, elsewhere a wide geographical range, which includes Tasmania, Australia, Brazil, Chili, and Chilöe, Juan Fernandez, and the Chonos Archipelago. I found it abundant in Saddlehill Bush, fringing the twigs and branches of forest trees, especially when decaying or dead, just as *Alectoria*, *Usnea*, *Evernia*, and other corticolous *Lichens* do in this country. Where these mosses occur, they appear to displace the *Usneæ*, *Stictæ*, and other *Lichens*, as well as various climbing or pendent

Ferns and *Lycopodia*, which, under other circumstances, so frequently clothe the trees of the New Zealand forests.

Like the pendent *Dendropogon* of Mexico, these New Zealand species of *Meteorium* and *Trachypus* are suitable for use as a packing material.

II. Hepaticæ.

Gen. *Androcryphia.*

Sp. *A. confluens* (Taylor). Lagoon in Kapuwaka creek, near Finegand station on the lower Clutha. An antarctic species, which does not appear hitherto to have been found in New Zealand.

" A curious thing," says Mitten in MSS., " allied to our *Jungermannia pusilla* (L.), and a link between the leafy and frondose Hepaticæ . . . I have fragments, ... that appear to indicate quite a new form. Unfortunately it is unique."

The following are recorded in " Flora Novæ Zelandiæ" as *North* Island species; but do not appear to have been collected in the *South* Island :—

1. *Frullania falciloba* (Hook. fil. and Tayl.). Creeping on the stems of *Madotheca Stangeri* (Gottsche). Greenisland Bush, near Dunedin. In the North Island it is said to frequent tree barks.

2. *Sarcomitrium prehensile* (Taylor). Occurs in my Dunedin herbarium; but the label having been lost, the precise habitat is unknown. The plant is pruinose when dry. It is a native of Cape Horn.

III. Algæ.

With the exception of the *Diatomaceæ*—a list of which is given elsewhere,* and *all* of which are new to Otago and New Zealand, though only three of them are new to science—this department of my Dunedin herbarium is more barren in novelties than any other, either cryptogamic or phænogamic. This arises, however, in great measure at least, from the circumstance that my collection was extremely local and limited—confined to a few of the *Marine* algæ of the Greenisland Bluff or Headland. With the single exception of Diatomaceæ, no collection was made of the *Fresh-water* or *terrestrial* algæ, a tribe which is destined to add very many species to the Flora of New Zealand.

* Proceedings of Linnean Society, February 20, 1865.

The only genera or species not hitherto found in New Zealand are,

1. *Palmella cruenta* (Ag.). Coating with a beautiful pink or peach-coloured blush, the white powdery surface of petrified moss. Caves in limestone, Woodburn, Saddlehill.

Both genus and species are apparently new to New Zealand—that is, they have not hitherto been recorded among its terrestrial algæ, though I have little doubt this British and widely diffused plant will yet be found to be common in the kind of habitats it usually selects at home.

2. *Hormosira Banksii* (Ag.).* Rock-pools (at low water), Greenisland Bluff.
3. *Cystophora platylobium* (J. Ag.). Rock-pools (low water), Greenisland Bluff.

The two following are recorded in "Flora Novæ Zelandiæ" as *North* Island species; but they do not appear to have been collected in the *South* Island:—

1. *Iridæa lusoria* (Harv.). Rock-pools (low water), Greenisland Bluff.
2. *Gigartina Radula* (J. Ag.). Rock-pools (low water), Greenisland Bluff. A native of the Cape of Good Hope, the Pacific Ocean, and the antarctic regions (Cockburn Island).

III. *Under the Snow, or the Flowering of Plants in Closed Cases.* By N. B. Ward, Esq.

The author remarked—One of my bed-room cases outside the window has been most glorious for the last month or two. According to Mrs Somerville, closed cases are as old as the creation. She says that any one travelling high up in the Alps in early spring cannot fail to observe *Leucojum vernum* (snowflake), and other spring flowers, flourishing in little closed cases of snow, with here and there a transparent icy roof, under cover of which the flowers retain their beauty for a very long period. Now, this Case of mine is a case in point, but the plants, instead of being sur-

* The determination of my *marine* algæ I owe to the kindness of Professor Harvey of Dublin.

rounded by snow and ice are surrounded by glass. The minimum temperature, as tested by a self-registering thermometer, is always within one, or at the most two degrees of that in the open air; but the immunity from the effects of cold arising from the perfectly quiet and pure state of the atmosphere is most striking. One flower of a cyclamen, which opened the second week in January, has not yet faded, and a double-blossomed camellia, which flowered most beautifully in the winters of 1863 and 1864, is now covered with flower buds just expanding—not one of the buds has withered or fallen; added to which are ten varieties of crocus, one or two of tulips and of Polyanthus-narcissus, the double white primroses, &c. The snowdrops are over. I was induced by the successful results of this case to build one of fifty feet in length at Chelsea, for the reception of innumerable lovely plants which do not require any artificial heat in winter, but which do want the protection afforded by the glass cover. This large case has now stood the test of two winters with most gratifying results. The aspect is the same as my own—viz., a little to the southward of east. Several varieties of camellias, six or seven species of cyclamen, several species and varieties of primula, and all the ordinary and extraordinary spring bulbs, fairy roses, Japan barberries, palms, *Clematis lanuginosa*, &c., are the ornaments of this house, backed by a large number of ferns, Lycopodiaceæ, &c., retained in their places upon the back wall by galvanised wire. The amount of gardening labour required is most trifling, no pots or tubs being used.

IV. *List of Plants in Flower in the Open Air, Royal Botanic Garden, Edinburgh.*

	1865	1864.
Nordmannia cordifolia, . . .	March 10	March 2
Scilla bifolia, ...	... 10	... 18
Omphalodes verna, ...	... 11	... 8
Doronicum caucasicum, . . .	... 14	... 7
Narcissus pumilus, ...	... 14	... 21
Symplocarpus fœtidus, ...	... 16	... 14
Erythronium Dens-canis, . . .	... 16	... 22
Scilla sibirica, ...	... 17	... 25
bifolia major, ...	... 27	... 20
bifolia alba, ...	... 27	... 26
Narcissus minima, ...	... 28	.. 21
Scilla bifolia rubra, ...	... 29	... 30
Draba aizoides, ...	... 29	... 26
Orobus vernus, ...	... 30	... 25
Daphne Mezereum, ...	... 30	... 27
Puschkinia scilloides, ...	... 30	.. 29
Erythronium grandiflorum, . .	... 30	... 22
Sisyrinchium grandiflorum album,	April 1	... 29
Corydalis cava, ...	... 1	April 5
solida, ...	... 3	... 6
tuberosa, ...	... 3	... 4
Primula nivalis, ...	... 6	... 1
Adonis vernalis, ...	... 6	... 14
Narcissus moschatus, ...	... 7	... 8
Hyoscyamus Scopolia, ...	... 7	... 9
Ribes sanguineum, standards, .	... 8	... 12
Ornithogalum exscapum, . . .	... 8	... 8
Muscari botryoides alba, . . .	... 9	—
Hyoscyamus orientalis, . . .	... 9	... 9
Fritillaria imperialis, ...	... 10	... 9
Sanguinaria canadensis, . . .	... 10	... 13
Hyoscyamus physaloides, . . .	... 10	... 9
Narcissus Pseudo-Narcissus, . .	... 10	... 2
Pulmonaria virginica, ...	... 11	... 13
Anemone nemorosa, ...	... 11	... 12
Narcissus Jonquilla, ...	... 11	... 12
Iris reticulata, ...	... 12	... 9
Ornithogalum montanum, . . .	... 12	... 9

A letter was read from Mr William Bell, dated "Botanic Garden, Saharunpore, 28th February 1865," in which he refers to a species of Loranthus (a parasite) which grows vigorously on many trees in the neighbourhood of Saharunpore. It is most partial to the common mulberry, while *Pinus longifolia* and the Casuarina are seldom infested by it. Mr Bell also gives a description of a species of Orobanche, another parasite, which infests the turnip roots in the garden. It has a thick fleshy root-stock, and often of a considerable size. He concludes his letter in saying that he has recently made more observations on the sexual organs of ferns and mosses, and has been led to the belief that the antheridial and archegonial cells are not the true generative organs of these plants.

Mr Sadler exhibited specimens of *Dicranodontium asperulum* of "Mitten's Musci Indici," collected at Mains Castle, New Kilpatrick, by Mr W. Galt.

Mr Gorrie exhibited twigs of *Cupressus Lawsoniana* with male and female flowers, and reported that these trees were this season flowering freely in Messrs Lawson's nurseries and elsewhere in Scotland.

Dr John Anderson, Calcutta, sent photographs exhibiting the condition of many of the trees in the Botanic Garden there after the late cyclone.

11*th May* 1865.—Dr Dickson, President, in the Chair.

The following gentlemen were elected Members of the Society:—

As a Resident Fellow.

Ramsay H. Traquair, M.D.

As a Foreign Member.

M. Dominique Clos, M.D., Professor of the Faculty of Science, and Director of the Botanic Garden, Toulouse.

The following donations to the Library were laid on the table:—

Deux Ascensions Scientifiques au Mont Blanc, par Charles Martins.—From the Author.

Die Flora von Königshorst, von H. Schulze.—From the Author.

Verhandlungen des Botanischen Vereins fur Brandenburg, Heft V.—From Professor A. Braun.

Bericht uber die Sechste Versammlung des Vereins in Wittemberg.—From the same.

Proceedings of the Royal Horticultural Society, London, Vol. V. No. 4.—From the Society.

The following additions to the University Herbarium were noticed :—

220 species of European mosses, named by Dr Schimper.

Specimens of *Orthodontium gracile* and *Grimmia trichophylla*, collected by Mr Robinson, Frodsham.

The following donations to the Museum at the Royal Botanic Garden were announced :—

From Charles Lawson, Esq.—Cusco Maize, from Peru.

From Dr Alexander Dickson—Birch and Willow wood affected by *Peziza æruginosa*, and assuming a green colour.

The following Communications were read :—

I. *On the Morphological Constitution of the Andrœcium of Mentzelia, and its Analogy with that of certain Rosaceæ.* By Alexander Dickson, M.D. Edin. (Plate IV.)

In his "Organogénie" Payer has given full details of the floral development in *Mentzelia* and *Bartonia*. He has pointed out the remarkable difference between the development of the andrœcium in these plants, where there is a centripetal evolution of stamens, and that in *Cajophora* and its allies, where the stamens appear centrifugally on cushions or bosses; stating his conviction that "these two series of genera ought to constitute, if not two distinct orders, at least two very distinct tribes of the same order."* In his "Leçons sur les Fam. Nat. des Plantes," he has adopted the first of these two alternatives, and broken up the old order *Loasaceæ* into two orders—the "*Mentzeliées*" and the "*Loasées.*" Summing up the essential characters of the *Mentzeliées*, he expresses himself in the following terms: —"By their *inferior*, *unilocular* ovary, with three *parietal* placentæ, by their *capsular* fruit and *albuminous* seeds, and by their regular quinary flower, the *Mentzeliées* approach the *Loasées*, but are widely separated from them by their

* Payer, "Organogénie," p. 890.

stamens, which are disposed in *several* whorls, and not in a single one [of five compound stamens], and the development of which recalls that of the Rosaceæ."*

Having been much interested by Payer's description of the development in *Mentzelia* and *Bartonia*, and by the analogy he has pointed out between their andrœcium and that of the Rosaceæ, I was induced to examine the development of the flower in *Mentzelia aurea* with considerable attention. I have been able to verify, in every essential, almost all the details given by Payer. My researches, however, although confirmatory of the accuracy of Payer's facts, have led me to adopt a very different interpretation of the morphological constitution of the andrœcium, my opinion being based, to a great extent, upon observation as to the period at which the carpels appear, a point to which Payer has not adverted.

In the young flower of *Mentzelia aurea*, from about the period when the petals make their appearance, the receptacle becomes concave or cup-shaped; and on the inner surface of this receptacular cup the stamens are developed in the following manner:—In the first place, there appear *five* stamens, alternate with the petals, and near the upper edge of the cup; then, a little lower down, a range of *ten* stamens, so disposed that each of the five primary is accompanied by two secondary stamens, one on either side; later, and still lower down, a third range, consisting of *twenty* stamens, arranged so that each of the ten stamens of the second degree is accompanied by two of the third, one on either side; then a fourth range, also of twenty stamens, alternating with those of the third degree; and lastly, some five or six still lower ranges, in centripetal succession, each consisting of twenty stamens or thereabout, which alternate pretty regularly with the members of the range preceding them. It is to be noted that, in such an arrangement of parts, it is in the fourth range that there first appear stamens superposed to the petals, and exactly intermediate between any two stamens of the first degree. This will be sufficiently apparent by reference to the diagram which I have constructed of the andrœcium of *Mentzelia*, and which represents the arrangement as satisfactorily as the difficulty of

* Payer, "Leçons sur les Fam. Nat. des Plantes," p. 114.

projecting, on a plane, points disposed on what approximately is the inner surface of a hollow cylinder, will allow. I have sometimes observed a slightly different arrangement, in which there are *fifteen* instead of twenty stamens in the third range, a single stamen replacing the pair superposed to each petal, so that the first stamens, which are exactly intermediate between any two primary stamens, are thus in the third instead of the fourth range. I mention this latter arrangement thus particularly, because it is strikingly like that in *Rosa*, to which I shall afterwards refer.*

Almost immediately after the stamens begin to appear, the central portion or bottom of the receptacular cup becomes more markedly and abruptly depressed, forming a narrow funnel-shaped cavity, the rudiment of the inferior ovary, which is distinctly defined at its margin from the outer and upper portion of the receptacle upon which the stamens make their appearance. Around the margin of this central funnel-shaped depression three semilunar elevations are developed. These three processes are the carpels, which afterwards form the style. They are developed at a very early period, the time of their appearance being almost coincident with that of the ovarian cavity itself. I have seen them distinctly present when the stamens of the third degree had just appeared as very faintly marked mammillæ, so that it is almost certain that they are developed before these stamens. Probably they are developed about the time of, or immediately after, the appearance of the stamens of the second degree. Whatever may be the exact moment of the appearance of the carpels, there can be no doubt that they appear long before the staminal evolution is completed.

Payer describes the development of the andrœcium in *Bartonia* as being essentially similar to that in *Mentzelia*, with this exception, that the five primary staminal mam-

* Payer gives no figures of *Mentzelia*, but he describes the appearance of the stamens as follows:—"Cinq se montrent d'abord alternes avec les pétales; elles sont bientôt suivies de dix autres placées deux par deux de chaque côté des premières et un peu plus bas, puis de quinze, puis de vingt-cinq, &c., de façon que l'entonnoir floral en est promptement tapissé." As stated above, I have sometimes observed *fifteen* stamens in the third range. I am unable, however, to say whether or not, in this arrangement, there are so many stamens as twenty-five in any of the succeeding ranges; but I should be inclined to doubt that there are so many.

millæ, instead of being developed as stamens, assume a petaloid development—whence the corolla of *Bartonia* is ordinarily described as consisting of ten petals. The number of stamens, however, is very much greater than in *Mentzelia aurea;* and it will be seen from the diagram (fig. 2), which I have constructed in accordance with Payer's figures, that there are no stamens exactly intermediate between the primary ones (the false petals) before the sixth range.

Having thus briefly detailed the principal phenomena connected with the staminal evolution in *Mentzelia* and *Bartonia*, I shall now proceed to consider what conclusions may be legitimately drawn therefrom regarding the nature of the andrœcium in these plants. Payer's opinion, as I have already stated, was that this andrœcium consists of several staminal whorls. His idea was, no doubt, suggested by the definite and regular manner in which the several ranges of stamens succeed each other on the inner surface of the receptacular cup. If, however, the andrœcium really consisted of a number of whorls, we should expect to find the carpels appear *after* the completion of the staminal evolution, and not before it. The fact that by far the greater number of the stamens appear after the carpels are developed, seems to me to constitute a fatal objection to Payer's theory.

If the general disposition of the stamens be attended to, it will be observed that the stamens of the first two or three ranges in *Mentzelia*, and of the first five in *Bartonia*, exhibit a distinct arrangement into groups superposed to the sepals. If, again, it be borne in mind that in almost all polyadelphous plants the carpels appear before the evolution of the stamens is completed, it cannot reasonably be doubted that we have here to do with five confluent compound stamens superposed to the sepals, with a centripetal evolution of lobes analogous to what Payer has described in the compound stamens of the Myrtaceæ.

Admitting the correctness of this interpretation of the andrœcium of *Mentzelia* and its allies, the question arises as to the propriety of separating them, as Payer has done, into a distinct Order from the Loaseæ. The researches of Payer have shown that in these latter the andrœcium consists of five compound stamens superposed to the sepals.

Thus far, therefore, the analogy between the andrœcia of the two groups would hold good. In the Loaseæ, however, the evolution of the staminal lobes is centrifugal as regards the axis, while that in the Mentzelieæ is centripetal. This difference is certainly a very striking one, but it may fairly be doubted if it is sufficient to separate into distinct Orders two groups of genera so closely allied in all other respects. The centripetal development of lobes in the compound stamens of the Myrtaceæ, to which I have compared that of the Mentzelieæ, was considered by Payer analogous to the basifugal evolution of leaf-lobes in ordinary leaves, while the commoner centrifugal development of staminal lobes such as that in *Hypericum*, *Tilia*, &c., he compared to the basipetal evolution of leaf-lobes. In a note, however, to my paper "On Diplostemonous Flowers" in last year's volume of the Society's Transactions, I ventured to question the correctness of the distinction which Payer has sought to draw between the two cases, as follows,—" Payer has somewhat hastily, I think, compared the compound stamens in the Myrtaceæ to leaves with lobes developed from base to apex, or basifugally (" Organogénie," p. 718). His figures, however, distinctly indicate that here, as in the ordinary form of compound stamens, there is a mesial stamen or lobe of the compound stamen, from which, as a point of departure, the evolution of the other stamens extends ; and it appears to me improbable that a basifugal succession of lobes should be initiated by the development of a lobe in the middle line at the base of the compound stamen. The phenomenon seems more naturally explained by supposing that the first-developed lobe of the Myrtaceous compound stamen corresponds to the first-developed or terminal lobe in the ordinary form, in which case the evolution in both cases would be basipetal ; the only difference between the two being that, while in the Hypericaceæ, &c., the lobes are developed on the back or outer face of the rachis of the compound stamen (the staminal cushion), in the Myrtaceæ they appear on its front or inner face. In confirmation of this opinion, I may refer to the highly developed staminal groups in *Melaleuca purpurea*, where, in each phalanx, the stamens evidently proceed from the *inner* face of the flattened and elongated rachis."*

* Transact. Bot. Soc. Edin., vol. viii. part 1, p. 100.

If this explanation of the centrifugal and centripetal modes of evolution in compound stamens be admitted, it will be seen that the difference between the Loaseæ and Mentzelieæ is not so great as might at first sight be supposed. At all events, it seems to me that systematists should hesitate, in absence of other diagnostic characters of any value, to break up the old Order Loasaceæ.

Having stated my reasons for holding the andrœcium of the Mentzelieæ to consist of five confluent compound stamens, I shall now consider some of the arrangements in the Rosaceæ, in which family Payer has pointed out an analogy in staminal evolution with that of the Mentzelieæ. I am induced to do so more particularly, because the explanation I have given of the andrœcium of *Mentzelia* and *Bartonia* seems to throw considerable light upon the morphology of that of the Rosaceæ. I have constructed diagrams, in accordance with Payer's figures, of the principal forms of staminal arrangement met with in this family, to which I shall refer in the following remarks. I have myself carefully examined the development of the andrœcium of *Rubus Idæus* and *Rosa spinosissima*; and to a certain extent observed that of *Comarum* and *Geum*.

In *Rubus*, soon after the appearance of the petals, the hemispherical termination of the receptacle comes to be surrounded by a flattish cushion. The external outline of the cushion is that of a pentagon with gently concave sides; and the petals form the angles. An examination of the earliest development of this cushion gives one the impression of its being produced by an extension and fusion of the bases of the petals. On the surface of the cushion the stamens are developed in the following manner:—First, *ten* stamens appear, one on either side of each petal, and closely approximated to it. From these points the evolution of the other numerous stamens extends centripetally. This development of stamens is accurately described by Payer as "une éruption de petits mamelons, qui commençant près les pétales, s'en éloignerait peu à peu."* In *Rubus tomentosus*, the species which Payer has figured, the series of stamens approaching each other from any two adjacent petals do not coalesce until the stamens of the fourth degree, as I have

* "Organogénie," p. 504.

represented in the diagram (Fig. 8). In *R. Idæus* I find that this coalescence usually takes place in the stamens of the third degree. I am satisfied that, in this plant, the carpels begin to appear considerably before the staminal evolution is completed; but, from the minute size of the staminal mammillæ here, it is difficult to determine the period very precisely.

In *Geum*, Payer describes the stamens as "very numerous, and disposed in whorls which alternate with each other, and appear successively from above downwards, on the inner surface of the receptacular cup, which is pretty deep. Each whorl is composed of ten stamens. In the whorl which appears first, and which, in consequence, has the highest place on the inner surface of the receptacular cup, the ten stamens are grouped in pairs in such a manner that there is one to right and left of each petal"* (fig. 10).

In *Rosa*, Payer describes the andrœcium as identical in its development with that in *Geum*, consisting of numerous alternating whorls of stamens appearing centripetally, each composed of ten stamens.† This statement, however, seems scarcely to agree with his figure of *Rosa alpina* ("Organogénie," pl. 100, fig. 26), where the stamens of the second degree are superposed in pairs to the petals and singly to the sepals, making, in all, fifteen stamens in that range; and where there is apparently, moreover, a similar number of stamens in each of the succeeding ranges. I have no doubt that Payer's figure is quite correct, as the same arrangement of the stamens of the second degree appears to be constant in *Rosa spinosissima*. The diagram (fig. 9) which I have given, may therefore be relied upon as an accurate representation of the staminal arrangement in *Rosa*.

In *Fragaria*, *Spiræa*, and *Cotoneaster*, Payer has shown that there is a first range of *ten* stamens, disposed, as in *Geum* and *Rosa*, so that there is one on either side of each of the five petals; then a second range of *five* stamens superposed to the sepals; and lastly a third range also of *five* stamens superposed to the petals (fig. 11).

The andrœcium in *Geum* and *Rosa* is that which most closely resembles, in its development, that in the Mentzelieæ. In looking at the young flowers, when the andrœcium first

* "Organogénie," pp. 501–2. † Ibid. pp. 502–3.

appears, it is striking to observe the great analogy which exists between the primary stamen in *Mentzelia* accompanied by two secondary ones, and the petal in *Geum* or *Rosa* accompanied by two stamens of the first range. In *Bartonia* the resemblance is still further heightened by the primary stamens being actually developed as petals. If we recall what I have mentioned as an occasional arrangement in *Mentzelia*, where there are *five* stamens of the first degree, *ten* of the second, and *fifteen* of the third, ten of these last being superposed in pairs to the primary stamens, and five alternate with them, the arrangement cannot fail to strike one as being extremely similar to that in *Rosa*, where there are, first the *five* petals, then *ten* stamens, and then *fifteen*, these last having exactly the same relation to the *petals* as the fifteen stamens of the third degree in *Mentzelia* have to the *primary stamens.* This analogy is so very close, that it seems impossible to doubt that whatever explanation holds good as to the one case must necessarily do so as to the other. If, therefore, my interpretation of the andrœcium in the Mentzelieæ be correct, it will follow that in *Rosa* and *Geum* the andrœcium consists of staminal groups, of which the petals, ordinarily so called, are the apices, just as the false petals in *Bartonia* are the apices of its staminal groups. In *Rubus* the evidence of staminal groups of which the petals are the apices is still more apparent, where the staminal evolution *manifestly* extends itself from five centres or points of departure, the centres being the so-called petals. As to *Fragaria*, *Spirœa*, and the like, their staminal arrangement only differs from that in *Geum* or *Rosa* in the number of stamens developed after the first range of ten.

It will be seen from the foregoing, that, if my reasoning be admitted, all the Rosaceous forms above described must be considered as, strictly speaking, apetalous; the andrœcium consisting of five confluent compound stamens with petaloid apices, alternate with the sepals. The genus *Alchemilla*, it appears to me, stands in a most interesting relation to these forms. Here the flower is also apetalous, but instead of a whorl of *compound* there is one of *simple* stamens alternate with the sepals. In *Alchemilla*, we have, I believe, so far from an aberrant form of staminal arrangement, as is generally supposed, in reality a type—complete, though of

elementary simplicity—of the andrœcium of a great portion of the family.

A second series of Rosaceous andrœcia is to be found in the genera *Aremonia*, *Agrimonia*, *Sanguisorba*, and *Poterium.* The development of the flower in these forms, as detailed by Payer, shows that they are characterised by having a single whorl of stamens *superposed to the sepals.* In *Aremonia* and *Agrimonia* there is a true corolla of petals alternate with the sepals, which in *Sanguisorba* and *Poterium* disappears. In *Aremonia* and *Sanguisorba* the stamens are simple, while in *Agrimonia* and *Poterium* they are compound. It is unnecessary to enter more fully into the description of these arrangements, as the diagrams I have constructed will render them perfectly intelligible.*

In accordance with the foregoing remarks, the staminal arrangements in those Rosaceæ of which the development is known, may be classified under two principal types, as follows:—

I. *Alchemilla-type.*—Single whorl of stamens *alternate* with the sepals. No true corolla.
- (*a*) Stamens simple: *e.g. Alchemilla* (fig. 7).
- (*b*) Stamens compound, confluent with petaloid apices: *e.g. Rubus* (fig. 8); *Rosa* (fig. 9); *Geum* (fig. 10); *Fragaria, Spiræa*, &c. (fig. 11).

II. *Aremonia-type.*—Single whorl of stamens *superposed* to the sepals. With or without a true corolla.
- (1) With a true corolla.
  - (*a*) Stamens simple: *e.g. Aremonia* (fig. 3).
  - (*b*) Stamens compound: *e.g. Agrimonia* (fig. 4).
- (2) Corolla absent.
  - (*c*) Stamens simple: *e.g. Sanguisorba* (fig. 5).
  - (*d*) Stamens compound, confluent: *e.g. Poterium* (fig. 6.)

It will be seen from the above that, if I am correct in

* The analogy of *Sanguisorba* and *Poterium*, with *Aremonia* and *Agrimonia*, indicated by this association, does not, perhaps, rest upon a very secure foundation. I have followed Payer, who remarks that "les Pimprenelles doivent être regardées comme les Aigremoines tétramères dont les pétales ont avorté." It is, however, with considerable hesitation that I have done so; because, if in *Sanguisorba* the sepals and stamens are developed in four pairs, in regular decussate succession, as Payer's researches seem to indicate, it is difficult to justify the assumption of an abortion of petals alternate with the sepals. Our knowledge, however, of the analogy between the arrangement of floral parts and that of ordinary leaves upon the stem, is as yet too imperfect to allow of any definite conclusion upon the subject.

my conclusions, *Alchemilla* bears to *Rubus*, *Geum*, or *Fragaria*, in staminal arrangement, the same relation as *Aremonia* does to *Agrimonia*, or *Sanguisorba* to *Poterium*. This tends strongly to confirm Payer's opinion, in which he followed the older botanists, that *Alchemilla* has really closer affinities with the Potentillidæ than with the Sanguisorbeæ, with which it has been more recently associated.

Perhaps a *third*, and possibly diplostemonous, type of Rosaceous andrœcium is to be found in those genera (*Sibbaldia*, &c.) included in the tribe Chamærhodeæ, but these require careful organogenic investigation.

Explanation of Plate IV.

In the diagrams the sepals are shaded: the true petals in outline. The stamens are represented by black spots, of which the larger indicate the older, the smaller the younger ones. The false petals, or petaloid staminodes, are indicated in black, like the stamens. The epicalyx, which is proper to some of the Rosaceous forms represented, is omitted, partly to make the diagrams of more general application, and partly to avoid unnecessary and perhaps confusing detail.

Fig. 1. Arrangement in *Mentzelia* (*Loasaceæ*). Calyx. Corolla. Stamens compound, confluent, superposed in the sepals.

Fig. 2. Arrangement in *Bartonia* (*Loasaceæ*). Essentially the same as in *Mentzelia:* only, the apices of the staminal groups or compound stamens are developed as petaloid staminodes.

Fig. 3. Arrangement in *Aremonia* (*Rosaceæ*). Calyx. Corolla. Single whorl of simple stamens superposed to the sepals.

Fig. 4. Arrangement in *Agrimonia* (*Aremonia-type*). The same as in *Aremonia;* only, the stamens are compound.

Fig. 5. Arrangement in *Sanguisorba* (*Aremonia-type*). Corolla absent. Of the four sepals, the antero-posterior pair are the older, the lateral the younger. Similarly the antero-posterior pair of stamens are the older, the lateral the younger.

Fig. 6. Arrangement in *Poterium* (*Aremonia-type*). Corolla absent. Sepals 4. Stamens 4, superposed to the sepals, compound, and confluent.

Fig. 7. Arrangement in *Alchemilla* (*Rosaceæ*). Apetalous. Sepals 4. Stamens 4, simple and alternate with the sepals.

Fig. 8. *Rubus* (*Alchemilla-type*).

Fig. 9. *Rosa* (*Alchemilla type*).

Fig. 10. *Geum* (*Alchemilla-type*).

Fig. 11. *Fragaria*, *Spiræa*, *Cotoneaster*, &c. (*Alchemilla-type*). In this and the three preceding forms the symmetry is quinary. The stamens, as in *Alchemilla*, alternate with the sepals; but instead of being simple, they are compound and confluent, with petaloid apices. No true petals. As the diagrams indicate, the staminal lobes vary in number in these forms; but, in all, the ten oldest stamens are disposed so that there is one on either side of each petaloid staminode.

Fig. 12. Section of young flower of *Comarum palustre: ec*, epicalyx; *s*, sepals; *p*, the so-called petals (petaloid staminodes); *st*, stamens of the first range, of which two accompany each "petal;" the other stamens have not yet appeared; *ax*, convex extremity of the floral axis upon which the carpels afterwards appear. Ultimately, the staminal arrangement is the same as in *Fragaria* (fig. 11).

II. *Report on the Cinchona Plantation at Darjeeling in February* 1865. By Dr Thomas Anderson.

Dr Anderson reports that the month has been less favourable than January, as the cold, which has been quite as great as in January, has been accompanied by a very dry state of the atmosphere. Hail fell on the 3d of the month and rain on five days, but with the exception of the 25th and 26th of the month only in slight showers, which did no benefit whatever to the Cinchona. The slight increase in growth took place almost entirely during the last five days of the month, with the exception of the lowest plantation, where about the 17th the plants began to show the first symptoms of the return of spring. At the first plantation (5500 feet above the sea) the temperature has been very low, causing the destruction of at least three plants of *Cinchona Pahudiana*, and affecting a few of *Cinchona officinalis*. At the second plantation (4350 feet above the sea) hoar-frost occurred in several nights in February, but no damage has been done to any plants at this elevation. Observations on the temperature of the air have been made with more or less regularity during the month at the third, fourth, and fifth plantations. At the fourth plantation (2550 feet above the sea) the maximum and minimum temperature in the shade was recorded every twenty-four hours during the month. The mean maximum temperature for the month at this elevation was 66°·18, the mean minimum 47°·93, and the monthly mean temperature 57°·05. At the fifth, the lowest plantation (altitude 1825 feet), fewer observations were made, as the plantation was visited daily by the person observing. The results from the detached observations there give 71°·56 as the mean maximum, and 47°·77 as the mean minimum, and 59°·5 as the mean temperature of the month.

The total number of plants, cuttings, and seedlings in the

Government plantation at Darjeeling on 1st February 1865 is as follows:—*Cinchona succirubra*, 4780; *C. Calisaya*, 23; *C. micrantha*, 944; *C. officinalis* and vars., 19,329; *C. Pahudiana*, 5092—total, 30,168.

III. *Abstract of a Report on the Pitayo Cinchonas.* By Mr Robert Cross. Communicated by Clements R. Markham, Esq.

Mr Clements R. Markham having been impressed with the importance of procuring seeds of the species of Cinchona which grow at and near Pitayo, New Granada, obtained the sanction of the Secretary for India to employ Mr Cross in the service. The first writer who described the country round Popayan and Pitayo was the Spanish Conquistador, Cieza de Leon. He accompanied the invading discoverers, who, starting from Darien in 1536, ascended the valley of the Cauca, and reached Popayan. The next author who treated of this region was the humane and generous but unfortunate Adelantado Andagoya, who was at Popayan in 1544. Ulloa, in his travels, gives a brief general account of the Popayan province. The only modern writers whó have preceded Cross are Humboldt, Caldas, Karsten, and Vigne. Humboldt crossed the paramo of Quindiu, ascended the valley of the Cauca to Popayan in 1801, and went thence to Pasto and Quito. During his stay at Popayan he made an excursion to the village of Purace. The learned Caldas was a native of Popayan. He was a good botanist and an excellent observer, and he knew the country well. Most of his writings are, unfortunately, still in manuscript, but some of them have been printed in the *Semanario de la Nueva Granada*, amongst which there is a very valuable geographical memoir written in 1807. Dr Karsten was for some years in this part of South America investigating the botany of the Andes. He made notes on the medicinal Cinchona barks of New Granada. Finally, Mr Vigne travelled for his amusement from Quito to Bogota, going over exactly the same route as Cross, and his travels were published in 1863. Among these writers, Caldas and Vigne are the only ones who have gone over the same ground as

Cross, and no one had given any account of the actual Pitayo forest previous to Cross's visit. Mr Cross remarks that most persons who have written on the Cinchona of the Andes represent it as flourishing amidst perpetual torrents of rain and mist, without scarcely ever enjoying a moment of sunshine. He states that this is a mistake. No Cinchona could live in such a climate, nor, even if planted in similar situations, could the trees ripen their seeds, for a certain amount of dry weather and sunshine is necessary for the ripening of the capsules, and for their bursting in order that the seeds may fall to the earth. The Cinchona climate is certainly moist for about six or eight months of the year, and in cultivating this plant it is expedient to seek very humid situations, because the mountains of India do not appear to receive the same amount of moisture as the lofty elevations in America. Nevertheless it will be understood that the natural climate of the commercial Cinchona has been misrepresented by most South American travellers. The Pitayo Cinchona differs essentially from the *C. lancifolia* of Karsten in being a more slender tree, often found formerly from 60 to 70 feet in height, but rarely more than 18 inches or 2 feet in diameter, with very slender branches, bearing small lanceolate leaves, which before falling always assume a purple or deep red colour. The *C. lancifolia* to which Karsten refers extends over a wider tract of country than any other Cinchona on the Andes. This tree, however, is much more massive, and bears considerably larger leaves than those of the Pitayo Cinchona. This large-leaved Cinchona inhabits the western slopes of the Cordillera Orientale, in situations presenting conditions favourable for its development, between Pasto and the city of Santa Fé de Bogota; while the finer kinds of Pitayo bark are limited to a few square miles of steep forest-covered slopes to the northward of the volcano Purace, which belongs properly to the central Cordillera. The map of the Cinchona region of New Granada lately made for Dr Weddel is very incorrect. It represents certain tracts of country as mountainous, and as covered with Cinchona forests, while in reality they are hot arenaceous plains, or savannas covered with low spreading leguminous trees, where no Cinchona ever grew. Karsten states that the bark is not taken from the roots of the *C. lancifolia*, which, in most

instances is true; but this is not the case with that of Pitayo, the bark from the roots of which is much more valuable than that from the trunks or branches. Further, he asserts that the *C. lancifolia* is never likely to become scarce, and that the continual cutting of the Cinchona trees will rather augment than diminish the number of plants; and this may be true concerning his *C. lancifolia*, about which no one cares much, as the yield of quinine is often too small to cover the expense of collecting; but as regards the Pitayo bark there is one thing very certain, that at the present time there is more difficulty in collecting one pound than there was formerly in collecting one hundredweight. The Pitayo bark will very probably be found the best of all the species for cultivation, as it is said to grow very rapidly, which is a matter of great importance. It may certainly be barked when it is six feet high, although it would not be an advisable practice to do so before the trees are at least 30 feet high. Bark taken from large trees in Pitayo was said to give nearly 4 per cent., while bark taken from the roots of the same trees gave 5 per cent. of quinine. All the bark taken from Pitayo is said to be sent to France. The bark sold in England under that name is not true Pitayo bark, but comes from the mountains which border on the valley of the Magdalena, and from Almaquer and Pasto, and is certainly from the *C. lancifolia* of Karsten, which as regards quality is very inferior to that of Pitayo. True Pitayo bark may be known in England by not being much thicker than common window-glass—because it is all taken from small plants, the large trees having been destroyed long ago, and by its being full of earthy particles, on account of so much bark being taken from the roots of the plants. The Cinchona alluded to by Karsten is rarely collected when less than one-fourth of an inch in thickness, but it is sometimes seen nearly an inch thick after the epidermis has been scraped off. Professor Jamieson, of Quito, analysed the Pitayo bark brought from the locality from whence the seeds were taken, and found it to contain 3·2 per cent. of quinine. There is therefore little doubt that this species and the *Cinchona officinalis* of Loxa will prove among the best for cultivation. The climate is like that of Loxa, and even the vegetation of both regions bears a close

resemblance to each other. The Andes of South America, from the southward of Loxa to the city of Santa Fé de Bogota, present great diversities of character, and even each particular tract of country possesses its own peculiar and distinctive features. Around Loxa many of the mountain ridges appear as if they had been scraped from top to bottom, and they are separated by deep ravines, on whose naked and almost perpendicular sides grow only a few stunted Cacti and Agaves. To the south-west of the valley of Catamayo, dry, rainless deserts extend to the frontier of Peru. However, on passing to the northward of Assuay the mountainous regions are covered with a dense vegetation; and above the forest limit are extensive grassy paramos, while higher still rise rounded elevations, or conical peaks, covered with perpetual snow. Beyond Pasto, the loftier regions bear an arborescent vegetation; but the hot, low-lying plains are mostly covered with coarse grass or low spreading Leguminosæ. From this point, until one reaches the great valley of the Magdalena, the mountainous region presents a most savage aspect of stupendous precipices, which form a kind of wall along the base of the eastern and central Andes. Throughout this vast territory, but especially along the course of the central Andes, runs a long line of burning mountains, active spouts of hot mineral water and sulphurous vapour, and bubbling mud volcanos. Don Narciso Lorenzano remarks that the principal motive which induced the Government of India to commence Cinchona cultivation, after overcoming so many difficulties, was the fear that the Quina trees would be extirpated in consequence of the waste that is allowed in the woods, where they are destroyed by the barbarous method of pulling up the roots. Fortunately this destructive method, which, without any doubt, would extirpate this precious plant in a few years, is only practised in the forests of Pitayo, where it is due to the immoderate desire for making money which has taken possession of the Indians, who own the greater part of the land. But in none of the other establishments for the collection of bark in New Granada has a similar practice been adopted. On the contrary, beneficial rules are observed for the conservancy of the woods. The method consists in leaving a part of the trunk, about three feet in

height, whence shoots may sprout, and in clearing away the surrounding trees to enable the rays of the sun to penetrate. By this means most of the trees that are cut down quickly shoot up, and, the rays of the sun penetrating to the cleared ground, the seeds which fall from the trees germinate freely. This result gives us full confidence that the good kinds of Quinas which exist in this country will be permanently preserved. We may conclude that there need be no fear that humanity will see itself deprived of this precious medicine, seeing that as well in Bolivia, as in Peru, Ecuador, and New Granada, the rule of cutting the bark according to a fixed plan is observed, and care is taken that the woods are replenished with increased numbers of plants of the best species, while some experiments have been made in forming plantations on lands where the best conditions for their growth are found. From all this we hope that in a few years we may see valuable results.

Dr D. Moore, Glasnevin, sent living plants of *Neotinea intacta* from Galway. He stated that he had seen about forty plants in the station, but only one of them was in flower. They grew on a dry bank close to limestone gravel.

Mr Sadler stated that Dr F. B. White had recently gathered the following rare mosses near Perth:—*Grimmia orbicularis*, rocks on Kinnoull Hill; *G. Schultzii*, on Dunsinane Hill; and *G. leucophœa*, *G. trichophylla*, *Hypnum abietinum*, and *H. rugosum*, on Callerfountain Hill.

Dr Dickson exhibited growing plants of *Pinguicula vulgaris* from various Scotch localities. The plants showed some marked differences in their flowers and leaves, and seemed to indicate at all events distinct varieties.

Mr M'Nab placed on the table growing plants of hybrids produced between *Primula vulgaris* and *P. veris*, and between *P. vulgaris* and *P. elatior*; also a plant of *Athyrium Filix-fœmina* var. *Victoriæ*, from Buchanan House.

Mr Gorrie exhibited specimens of a large blue-flowered Anemone, found naturalised at Cullen House; also a plant of *Myosotidium nobile* from Chatham Island.

8th June 1865.—Professor BALFOUR, Vice-President, in the Chair.

The following gentlemen were duly elected Members of the Society:—

ARTHUR GAMGEE, M.D.
JAMES CUMMING, Esq.

The following donations to the Library were laid on the table:—

Plants indigenous to the Colony of Victoria, Australia. Described by Ferdinand Mueller, Ph.D., M.D., &c.—From the Author.

Lithograms.—From the Victorian Government.

Fragmenta Phytographiæ Australiæ. By Ferdinand Mueller, Ph.D., M.D., &c.—From the Author.

Proceedings of the Literary and Philosophical Society of Liverpool, 1863–64.—From the Society.

Catalogue of British Plants, including the Flowering Plants, Ferns, and Characeæ, to which is appended a List of the Varieties of British Ferns. Printed for the Society, and published by Messrs A. & C. Black.

Botanisk Reise i valdersog de tilgrændsende egne, af Axel Blytt.—From the Royal University of Norway.

Les Ajuga Pyramidalis et Genevensis. Par M. Armand Thielens.—From the Author.

Observations sur Quelques Plantes rares ou nouvelles de la Flore de Belgique, par M. Thielens.—From the Author.

The following donations to the Herbarium were announced:—

From Dr W. F. Mactier—Collection of Ferns from Penang.

From Mrs Bevan, per William Brand, Esq.—Plants from Mont Blanc.

From Mr James Backhouse, York—Specimens of *Viola arenaria*, collected at Widdybank Fell, Teesdale, Durham, May 1865.

The following donations to the Museum at the Royal Botanic Garden were announced:—

From Mrs Millar—Fiji Woman's Dress made from Grass. Specimen of Gum Arabic, Leguminous Fruit and Bark.

From Miss Maclagan—Fruit of the Grapple Plant (*Uncaria procumbens*), from Africa.

From John Hutton Baikie, Esq., Kirkwall—Various Fruits, Seeds, &c., collected by the late Dr William Balfour Baikie of the Niger Expedition.

The following Communications were read:—

I. *Note on a New Gall from China.* By Professor ARCHER.

Mr Archer first referred to a gall described by Dr Pereira, under the name of Woo-pei-tsze, which had recently been imported into this country for the manufacture of gallic acid. Mr Hanbury believes it to be produced on *Rhus semialata*, and Mr Doubleday thinks it is caused by the puncturing of an aphis and not by a cynips. He next noticed a gall from India called Mahee, the produce of *Tamarix indica* and *T. furas*, and rich in gallic acid; also a peculiar gall called Kakrasingee, yielded by *Rhus Kakrasinghee* (Royle), and one from Southern Germany named Knoppern, produced on *Quercus Cerris*. In conclusion, he noticed a curious gall from Shanghai, resembling somewhat the Chinese and Japanese galls, but wanting their peculiar branched appearance.

II. *Note on Cape Saffron.* By Professor ARCHER.

This saffron is the produce of a plant belonging to the natural order Scrophulariaceæ, and is noticed by Dr Pappé in his "Flora Capensis." It yields a good orange dye, and resembles common saffron in taste and smell.

III. *Notice of Cubebs from Southern Africa.* By Professor ARCHER.

Mr Archer believed the cubebs to be the fruit of *Vepris lanceolata* (Jussieu), a plant belonging to the natural order Xanthoxylaceæ.

Specimens of the various galls, saffron, and cubebs referred to were exhibited.

IV. *Notes on the destructive effects of Beetles on certain Young Plantations.* By Mr JAMES MYLES, Factor to Mr Speirs of Elderslie. Communicated by Mr GORRIE.

The plantations chiefly attacked are Wraes, Kirkton, and Borthwickfield—the former having been planted three years, and the latter two years. The plants in Wraes are so much injured that nothing can be done to save them, and cattle have been turned into the plantation. In Kirkton more than one-half of the plants are killed, while in Borthwickfield the number destroyed is considerably less than the half. The beetles attack the plants first at the base of the stem, eating and then puncturing the bark upwards. The plants destroyed are Scots fir, larch, spruce, Austrian and Weymouth pines, and other coniferous trees, and a few specimens of beech, birch, oak, and mountain ash. The beetles occur in great profusion, and Mr Myles gave a description of what he had done to diminish their numbers. Three boys were able to collect for some time between 1300 to 1400 beetles each day in the plantation, and they had so far diminished now that they could only gather 600 or 700 a day. Mr Myles sent specimens of the beetles and plants injured by them. Mr W. R. M'Nab, who had examined the insects, finds three different species—viz., *Hylurgus piniperda*, *Hylobius Abietis*, and *Otiorhynchus notatus*.

V. *Notes of an Excursion from Simla to the Valleys of the Giri, Pabur, and Tonse Rivers, tributaries of the Jumna.* By HUGH CLEGHORN, M.D.

In regard to the first or most western stream (Giri), he observed that the valley is low, warm, fertile, and dotted with scattered cottages; the mountain slopes are bare. The principal trees observed in addition to the pines mentioned were—*Melia sempervirens*, *Pistacia integerrima*, *Ficus religiosa*, *Putranjiva Roxburghii*, *Populus ciliata*, *Salix*, *Alnus nipalensis*, *Pyrus*, *Cerasus puddum*, *Xanthoxylon hastile*, and *Cotoneaster microphylla*, carpeting the rocks. The crops are wheat, barleys, several millets, til (*Sesamum orientale*), tobacco, opium poppy, and various pulses (*Vicia*,

Ervum, and *Phaseolus*). There is no rule for rotation of crops; the hill men sow the same seed in the same ground in successive seasons, and if any villager changes the crop it is from his particular choice.

The valley of the Pabur is wider and more verdant than any other seen in this part of the Himalaya. Elms and horse chestnuts, walnuts and mulberries, occur near villages. Many of the trees are mutilated from the tender branches and young shoots being annually cut off to be stored as winter fodder for cattle. The dried twigs are lodged in the fork of the denuded trees, and secured with grass ropes; whence, when pasture is scarce, a bundle is taken as required. *Pistacia integerrima* (kakkar) is frequent on the river bank below Raeenghur; many trees were seen which would yield planks 10 feet long by 2 feet broad. Apricots, peaches, and plums abound in this beautiful glen. The Himalayan alder (*Alnus nipalensis*) is a large and straight tree, fringing the river banks above the junction of the Tonse. In addition to these, *Berberis Lycium*, *Prinsepia utilis* (bekul), and *Eleagnus conferta* (gehai), are economic plants, useful in various ways.

The following remarks were made as to the agricultural produce of this alpine valley:—

Broad river terraces, from four hundred yards to a quarter of a mile in width, are devoted to rice cultivation, for which this valley is celebrated, and through these the traveller's path lies. In spring, the opium poppy is largely cultivated, but in small patches; at the date of our visit (April), the plants were several inches above ground. The capsules are small, the lancet for making the incision resembles that used in the plains. Tobacco, Sesamum, and vetches, including *Ervum hirsutum* (masur), are grown in small quantity. In warm situations, barley is sown in March; wheat and several millets are likewise extensively cultivated. There was great abundance of wild mustard (Sinapis), used for the purpose of obtaining oil. The poppy and tobacco ground is frequently weeded, and is kept clean. Previous to its being ploughed by the men, cattle manure is carried out in kiltas (long deep baskets) by the women, upon whom all the drudgery devolves. The articles of export from the valley are wheat, barley, rice, tobacco,

opium, tar, kelu oil, apricot oil, ginger, hides, iron, wool, potatoes, honey, and wax. Above Shergaon, towards the Burenda Pass, the food of the people consists chiefly of buckwheat (phapar) *Fagopyrum esculentum;* the red amaranth (bhatu), and the smaller millets (chini and koda), *Panicum miliaceum* and *Paspalum scrobiculatum*, with mandua, *Eleusine coracana.* In September and October this amaranth gives rich tints of carmine, orange, and yellow to the landscape, while the buckwheat assumes a delicate pink.

A note was read from Dr Paterson, Bridge of Allan, referring to a double-flowered *Orchis mascula* which he had recently picked in Keir grounds.

Mr M'Nab placed on the table a collection of flowering alpine and other plants, including *Villarsia parnassifolia* from St George's Sound; a species of Drimmia from Africa, sent by Dr John Kirk; and a specimen of Monsonia, in flower.

13th July 1865.—Dr Dickson, President, in the Chair.

The following donations to the Library were laid on the table:—

Catalogue of the Indigenous and Exotic Plants Growing in Ceylon. By Alexander Moon, 1824.

History of Drugs. By M. Pomet, 1748.—Presented by Mrs Bevan, per Mr Brand.

The following donations to the Herbarium were announced:—

From Mrs Royle—Part of the Indian Collections of her husband, the late Dr Forbes Royle, transmitted through Dr Forbes Watson.

From Mr John Sim, Perth—Specimens of *Potamogeton nitens.*

From Dr F. B. White—Specimens of *Tortula Mülleri*, collected near Craiglockhart.

From Mr P. K. Vartan, Medical Missionary—Plants from Nazareth.

From Professor Piazzi Smyth—Plants from Egypt.

From Dr G. R. Tate—Specimens of *Atriplex laciniata*, from Isle of Wight.

The following donations to the Museum at the Royal Botanic Garden were noticed :—

From Dr Cleghorn—Bark of *Bauhinia diphylla.*

From Dr G. Bidie—Sandal-wood Oil and the roots of a plant used as Salep in India.

From Dr Thomas Balfour—Seeds of a species of Coix.

From Dr Mackenzie—Fan made of palm leaves and bamboo cane.

The following Communications were read :—

I. *Supplementary Notes upon the Vegetation of the Sutlej Valley.* By Hugh Cleghorn, M.D.

After exploring the valleys of the Pabur, Giri, and Tonse, tributaries of the Jumna, the author proceeded, in April and May 1862, to inspect the wooded tracts of Bussahir, to the northern limit of the Deodar Forests. The official report has been printed by the Punjab Government, but some extracts of his diary, interesting to the Botanical Society, were read. The peculiarities of the Simla Flora were enumerated.

Works of reference on the Valley of the Sutlej.—Much reliable information concerning the climate and productions of the Sutlej Valley, is contained in Gerard's "Kunawar," 1833, with Captain J. D. Cunningham's "Notes" in the "Jour. As. Soc. Beng." xiii. (1844); in Jacquemont's "Voyage dans l'Inde," 1844; in "Thomson's Travels," 1852; Cunningham's "Ladak," 1854; and in various papers of Major Madden, Captain Hutton, and Mr W. Theobald, jun., in the "Jour. As. Soc. Beng."

Hindostan and Thibet Road.—The Right Honourable the Governor-General of India, the late Marquis of Dalhousie, planned and commenced, during his administration, this imperial line of traffic from Hindostan to Central Asia, from which, even in an unfinished state, great benefits undoubtedly have arisen. The road was commenced in 1850, under the superintendence of Major Kennedy, and afterwards of Captain D. Briggs. The original idea was, that the road should be available for wheeled carriages through its entire length; this plan has now been abandoned, and a good road for laden mules is in progress to

the Chinese boundary. A branch road has been made from Kotgur to Serahan, *via* Rampur, the capital of Bussahir, and the principal resort of traders from the north as well as the south.

Kotgur.—Kotgur, four marches from Simla, was the residence of the Brothers Gerard, who surveyed the whole valley in 1815–21, and Captain A. Gerard has described it in his "Account of Kunawar." In the neighbourhood of Kotgur, the deodar existed at one time in considerable quantity, but did not attain a very large size. The valley is richly cultivated, and dotted with numerous villages; rice is grown below, barley and red amaranth above. Kotgur is a station of the Church Missionary Society. There is a flourishing tea plantation belonging to Mr S. Berkeley, who has introduced into his garden many European fruits and vegetables, including vines, pears, gooseberries, currants, &c. As the road to Kullu passes Kotgur, a considerable number of travellers visit this small station. A daily post connects it with Simla, and there is a resident thannadar.

The following is Captain Gerard's table of the mean temperature in-doors at Kotgur, in 1819–20:—

January	......	39° F.	July	......	69° F.
February	......	43	August	......	69
March	......	51	September	......	66
April	......	57	October	......	59
May	......	63	November	......	48
June	......	69	December	......	45

Rope Bridges.—Jhulas or rope bridges exist at Rampur, above Serahan, opposite Miru, and at Poaree, but whether swinging or suspension bridges, they are equally unsuited for the passage of sheep and mules, and the want of bridges is much felt.

Wangtu Bridge.—The breadth of the Sutlej at Wangtu is about ninety feet: the height of its bed, as determined by Gerard, 5200 feet. The remarkable wooden* bridge which here spans the river is the finest specimen of the kind I have seen. The square towers on either bank are

* See Jacquemont's drawing of this bridge, *Atlas*, plate 32.

about fifty years old, and existed before the bridge was destroyed during the Gurkha invasion (Gerard, p. 37); the beams laid across were renewed in 1859; the falling of the bridge in that year threw back a great part of the traffic into other channels. The permanence of this crossing is of vital consequence to the trade with Central Asia, and the pushm* traders and grain merchants whom we met coming down the valley, inquired earnestly as to the state of "Oangtu," which was the only bridge in Kunawar by which laden sheep and mules could cross the Sutlej. Since my visit a substantial new *sango* has been built under the superintendence of Captain A. M. Lang, R.E.

Want of Medical Aid.—My professional knowledge was called into play in answering endless applications for medicine. Throughout Bussahir, the hill villagers gather round the traveller imploring advice; their faith in the skill of European physicians, and in the efficacy of our drugs, is remarkable and embarrassing.

Diseases of Kunawar.—In Bussahir the inhabitants suffer from goitre, but not so much as in the valleys of the Pabur and Tonse; the general impression is, that the disease arises from drinking snow-water, but this is erroneous, as the people in the higher valleys do not suffer so much as those in low situations.† In Upper Kunawar fevers are rare, while in the lower part of the Sutlej Valley they are not uncommon. There is a very large amount of ophthalmic disease; the eyes become inflamed by the reflection from the snow, and are further injured by rubbing with dirty woollen cloths. Rhubarb leaves and hair-spectacles are used in summer to protect the eyes in crossing the passes, and travellers ought to be provided with gauze veils or neutral tint glasses. Fresh butter, which may be made in a bottle, should be applied to the eyelids when suffering from snow blindness. The other prevalent ailments are catarrh, rheumatism, and syphilis.

* The fine wool of which shawls are made.

† Dr Hooker makes the following ingenious suggestion—"May not the use of the head-strap be a predisposing cause of goitre, by inducing congestion of the laryngeal vessels?" I do not think this can be the cause, as in Bussahir it is the universal practice to use shoulder-straps and very rarely head-straps, and the disease is not uncommon among hill chiefs whose cervical muscles have never supported a load of any kind.

Climate of Chini.—The peculiar advantages of Chini, in possessing a dry climate and congenial temperature, are very remarkable. The notes of Dr A. Grant, physician to the Marquis of Dalhousie, which appeared in the "Annals of Medical Science," No. 1, 1854, contain the best account of the climate and advantages of this retreat,* where the Governor-General resided during the hot weather and rains of 1850. A summary of Dr Grant's observations will be found in the "Report of the Sanitary Establishments for European Troops in India," No. 1, p. 73 (Calcutta, 1861).

Agriculture is capable of little extension, from the precipitous character of the hills and the small proportion of arable land. All the available ground is laid out in terraces, and the cultivation is carried on with great care; the soil is often good, and the small fields are enclosed with loose stone dykes. As soon as the snow melts ploughing commences, and the women are sent out with baskets of manure. Every cultivator heaps up before his door, or under the house, the dung of all the sheep and cattle, and mixes them with the dry grass and leaves used for littering the animals. Oak, pine, and rhododendron leaves are most used for this purpose. To this are added the dried capsules of poppies, walnut shells, and apricot stones, with refuse chaff, when not required for fodder. Indeed, this branch of rural economy is well attended to by the hill tribes; and those substances having lain during the winter months, are found to be well rotted in spring, when they are applied to the soil both at the time of sowing and when the poppy and tobacco plants appear above ground.

In Kunawar, the lands of few villages produce more grain than the inhabitants require, and food is annually imported into the district. In times of scarcity the people eat Himalayan chestnuts (*Pavia indica*) and apricot kernels. These are soaked in water for a night to remove the bitterness, and are afterwards ground into flour and mixed with the inferior millets, forming large cakes. A great demand for food has arisen from the influx of sportsmen and other summer visitors, who annually increase in number. The Agri-Horticultural Society of the Punjab grants a yearly supply of vegetable seeds for distribution among the inhabi-

* See also "Benares Magazine," vol. viii. p. 938.

tants, and encourages the growth of esculents in the Himalayan valleys. Many European and American vegetables have been introduced, and grow well. The potato, in particular, thrives remarkably, though the inhabitants in the upper valley do not yet cultivate it to any extent. For several stages from Simla the increased cultivation of this esculent is very surprising, and it is largely exported to the plains of the Eastern Punjab for the commissariat stores of our European troops. The system of culture pursued was described. Steep slopes are preferred on account of drainage. The soil is generally loose and stony. The underwood is first cleared and burnt, and the deodar trees are removed—the Spruce fir (*Abies Smithiana*) not being valued as timber is killed by barking, and the trunks fall in one or two years. The oaks alone remain for shade, and are gradually felled for charcoal. After manure has been supplied to the soil, the potatoes are planted in the middle of April or May upon narrow terraces. At the close of the rains, five months after planting, the tubers are dug up fully ripe. They are packed tightly in woollen bags, and despatched, generally on mules, to the plains. These are relieved of their burden twice a day, when the sacks are thrown down carelessly at halting places, which bruises the potatoes. The plan of packing them in boxes might secure more careful transport. Turnips are sown after the cereals have been reaped; they are eaten fresh, or stored for winter use. In crossing to the Asrang Valley, the guide carried no food except four or five half-dried turnips not much larger than a billiard ball.

Timber procurable.—While the deodar is the most valuable and abundant tree of the Sutlej forests, many other useful woods may be mentioned. Vast forests of oak occur in various places,—as upon the east side of Hattu, on the upper track between Mattiana and Nagkanda, in Mandi, and Sukhet. The trees are of great size, 80 to 100 feet in height; they prefer dry situations, and are not generally convenient to the river. The logs do not float the first and second years, being in this respect like the black wood of Malabar (*Dalbergia latifolia*). Oak wood has been well reported of by General Cautley, at Marri; Mr Smithe, Superintendent Workshop, Madhopur; and by Dr Campbell, of

Darjeeling.* When the cart-road to Nagkanda is opened out, fine straight logs of oak may be brought into Simla. If approved of by the railway officers this timber might be supplied from the Hill States, and launched below Kotgur, supported by bamboos, or lashed to pine logs. Several species of oak are much used for railway sleepers in North America, and there can be little doubt, from their great density, that two of the Himalayan oaks are useful timbers. In colour and grain the *mohru* resembles the British oak.

Other Hard Woods.—There is abundance of yew and olive, and a considerable quantity of box and ash in the valley of the Sutlej. The ash, box, and olive occur near the river; the yew prefers the higher slopes, and is generally 2000 feet or more above the bed of the Sutlej. The ash and yew are much esteemed for jampan poles, tool handles, &c. The former in colour, grain, and toughness resembles the English ash. The box and olive, being hard and close grained, might be useful to the railway company for wedges and trenails.

These are the principal timbers of Bussahir, which, from their abundance and varied qualities, are valuable for engineering purposes. There are others, as maple, elm, walnut, plane, and alder trees found in smaller quantity.

Vine Culture.—In upper Kunawar the vine is extensively cultivated, and ripens its crop at an elevation of from 6000 to 9000 feet. The first plants are seen at Nachar, but the climate there is not suitable. Beyond the Miru ridge, which intercepts the heavy clouds, the smaller amount of rain favours the ripening of the grapes. The vineyards occupy sheltered situations generally on the steep slope facing the river. The vines are supported on poles three or four feet from the ground connected by horizontal ones. The fruit hangs below the shade of the leaves, never exposed to the sun. A considerable portion of the crop is dried on the housetop and stored as raisins for winter use, but without care, and many grapes are spoiled in the process. For several years the crop has been deficient, the grapes dropping off before they were ripe from unseasonable falls of rain and snow. In 1864, the rain-fall was moderate, but the *oidion*, or vine disease, appeared in the valley and

* Journal Ag. Hort. Soc., vi. Pro. 119.

destroyed many vineyards. The fresh fruit is exported to Simla for sale in kiltas or large hill baskets, and the small seedless grapes, dried, are also sold there as "fine Zante currants," at 2 rupees per pound. At Akpa and Poari the price of fresh grapes is about one rupee for a kilta-full, say 30 pounds. "Sungnam is the highest point in the valley where the vine thrives." (*Jacquemont's Letters*, p. 286.)

Useful Plants of Kunawar.—An admirable description of the configuration of the hills, and of the botanical features of the valley of the Sutlej, is contained in Thomson's "Travels in the Western Himalaya." In determining the native names of the plants of Bussahir, much assistance may be derived from consulting the copious Index of Royle's "Illustrations of the Botany of the Himalaya," and Jameson's "Report of the Botanical Gardens, North-West Provinces, 1855." A tolerably complete list of the useful plants between Rampur and Sungnam, which the traveller along the Hindostan and Thibet road may expect to find, has appeared in the present volume of the Transactions of this Society, page 77.

II. *Notes on the Forests of India.* By Dr Brandis, Inspector-General of Forests in India.

The author described the characteristic vegetation of the different classes of forests in Burmah, which he has superintended for ten years, and contrasted their general appearance with those of the Sal forests at the foot of the Himalaya and the less luxuriant forests of the Central Provinces; he also adverted to the system of valuation surveys, which has been introduced into British India, as the only safe basis of conservancy.

Professor Balfour, in remarking on Dr Cleghorn's and Dr Brandis' papers, observed that the Society were glad to welcome Dr Cleghorn back from India, where he had attained high eminence as conservator of forests. They had also the satisfaction of seeing this evening among them Dr Brandis, the head of the department, who is charged with organising the conservancy of forests for all India;

and Dr John Kirk, who had gone through all the trials of the African expedition with Dr Livingstone; and Dr Wight, the distinguished author of various works on Indian botany.

III. *On the Influence of Forests on Climate.* By M. Becquerel. Translated by G. M. Lowe, Esq.

Mr Lowe gave a condensed account of M. Becquerel's paper on "Forests and their Effects on Climate," read before the French Academy in May. The first portion of the paper gives an account of the extent of forest land in France from the time of Julius Cæsar; the second is on the action of forests on climate. This, he says, depends, *firstly*, on their extent; *secondly*, on the height of the trees and their nature, whether having caducous or persistent leaves; *thirdly*, on the amount of evaporation by the leaves; *fourthly*, on their capability of absorbing and radiating heat; and *fifthly*, on the nature and physical condition of the soil and subsoil. This influence is also exerted on running streams and springs.

As a shade against winds, the action of forests is incontestable, and this preservative action is of course enhanced by the increased height of the trees.

Evaporation by the leaves is a powerful and incessant cause of humidity, the least atmospheric cold precipitating the moisture evaporated, and the rain which results penetrates the soil directly, if it is permeable, and by the intervention of the roots if it is not.

The calorific state of the trees is shown by means of the electric thermometer, which has been employed for this purpose for many years; the result of numerous experiments being that the trunks, branches, and leaves grow warm or cold in air like inorganic bodies. The mean temperature above the trees is, towards the north, a little higher than that of the air at a distance from the trees.

The trunk, when its diameter measures 3 or 4 centimetres, does not acquire its maximum temperature until after sunset. In summer, this occurs about nine o'clock in the evening, whilst the atmospheric temperature attains its

maximum about two or three o'clock in the afternoon, according to the season.

Variations of temperature in trees take place very slowly, and rapid atmospheric changes have no influence on them.

When leaves cool by nocturnal radiation, they recover their lost heat from the body of the tree. About six in the morning, the temperature above a tree is equal to that at one metre above the soil north and south of it.

It may be conceived, therefore, how trees which have been heated by solar radiation can act on the temperature of the air, and not lower it as much as has been supposed. The influence of disforesting on the mean temperature has been studied as follows:—

M. Boussingault, by means of observations made by him and other travellers in the equinoctial regions of America, comes to the conclusion that abundance of forests and moisture tend to cool a climate, whilst dryness and aridity of the soil raise the temperature. Humboldt, on the other hand, in discussing thermometrical observations made in South America from 1771 to 1834, over an area of 40° long., states that they tend to show that the mean temperature of a climate is not changed by the destruction of great numbers of forests. He also made out that, though the mean temperature remained the same, yet the distribution of heat in the course of years was changed so as to produce an alteration of climate. Nevertheless, Humboldt acknowleged that the destruction of forests ought to increase the mean temperature by removing many causes of cold.

The nature of the soil uncovered by the removal of forests has not been taken sufficiently into consideration in examining this question. The temperature of the soil varies according to whether it is dry or moist, calcareous, siliceous, or argillaceous. The difference of temperature between a dry and a moist earth exposed to the sun is from 6° to 7° Cent., when the temperature of the air is 25° Cent. The nature of the soil is also important; thus an earth covered with flint stones cools more slowly than one covered with sand, and a pebbly earth therefore contributes more to the maturation of vines than chalky or clayey soils which cool more rapidly.

It is in this subject we must seek for an explanation of the contradictory results obtained by Humboldt and Boussingault. It is seen that the disforesting of a tract having siliceous or silico-calcareous soil ought to elevate the mean temperature of the air more than other earths. Thus, the western parts of Europe owe the mildness of their climate to currents of warm air which arrive from the desert of Sahara, but if in the course of ages the sands of Sahara came to be wooded, the climate would be more severe. This is precisely what has occurred in the mean latitudes of Northern America. The tropical regions of the American continent are occupied by vast forests, immense savannahs, and great rivers which give rise to no warm currents of air to modify the climate of the north. Thus, at equal latitudes America is more cold than Europe, as is proved by the direction of the isothermal lines, and by its agriculture.

The rest of the paper is on the effect of forests on the quantity of running water in a country, the evidence of which is chiefly historical.

IV. *On the History and Structure of Urococcus.* By Charles Jenner, Esq.

The remarkable, though minute, plants to which this evening I ask your attention, have been constituted a genus of the family Palmellaceæ.

Until the publication of Hassall's Fresh-Water Algæ in 1845, Urococcus had been grouped with the genus Hæmatococcus of Agardh; but since the time that the characteristic species of that genus have been classed with Protococcus and Glœocapsa, the distinctive peculiarities of Urococcus must have been overlooked. We need not wonder at this, when we consider the small size of the plant, the exceeding translucency of its structure, its comparative rarity, the little exact attention given to the study of this class of organisms, and the absolute want of good penetrating as well as defining power in the ordinary microscopes of the day. I can only in this way account for the curious peculiarities of this plant having so long remained unnoticed.

The structure that distinguishes Urococcus from all other known structures in the vegetable kingdom, has attracted the attention of all who have since had the plant under observation, and not only Hassall but also Berkeley, Professor Braun, and Professor Henfrey have alike desiderated more information in regard to it. Referring to the size of the plants, I may here state generally that the length of the stem varies from $\frac{1}{1000}$th to $\frac{1}{150}$th part of an inch, and the diameter from $\frac{1}{1000}$th to $\frac{1}{4000}$th part of an inch. I have measured some whose diameter did not exceed $\frac{1}{7000}$th of an inch, but the general diameter is from $\frac{1}{3000}$th to $\frac{1}{4000}$th of an inch. The plant came under my notice in the autumn of last year. I was in Arran for a few days collecting fresh-water algæ, directing my search more particularly to Palmellaceous plants; I had no microscope with me, and only careful search among my gatherings at home rewarded me with the finding of Urococcus. The drawings we have of the plant seem all to have been copied one from another; and anything more unlike its beautiful free-growing habit in nature, than the delineations we have of it in Hassall, Berkeley, and in the Micrographic Dictionary, can scarcely be realised. It is the difference between a commercial log of timber and the tree from which it was taken. The descriptions, too, of the plant are, as may be supposed, very imperfect. Hassall observed what he regarded and called a peduncle, and in consequence separated it then from the genus with which it had been associated by Agardh. Kutzing would appear not to have had the plant under his observation. Certainly it is not, as Hassall suggests, the *Hæmatococcus sanguineus*, nor the *Hæmatococcus cryptophyllus* of Kutzing (now *Glœocapsa sanguinea* and *Glœocapsa cryptophylla*), for we have both these plants yet, independently of Urococcus. In virtue of this peduncular process, as he called it, Hassall named it Ourococcus.* His station for it is the Dripping Well at Knaresborough, in Yorkshire. I do not know if it is yet to be found in that place, not having been there.

The process, which Hassall called peduncular, and in which he is followed by others, is no more a peduncle than the stem of a palm is a peduncle, or the bole of an

* Glœocapsa, from γλοιος, dirty, and καψα, a case or cist.

oak is a peduncle; it is just the stem of the plant, as I shall presently show you. Its bare outline, however, is so peculiar among allied genera, that Hassall's character sufficiently distinguishes it from others. He gives four species —Hookeriana, insignis, Allmanni, and cryptophylla, the two latter forming a sub-genus. In the first two he found striations on the peduncle; on the two latter none. The more we know of these plants the less will these definitions serve. The genus must be studied. Many new species will be found, I have no doubt, and it ought to have that distinctive position in our classification which its importance, in a physiological and morphological respect, renders desirable.

However unnecessary any consideration of the individual cell may be in speaking of the structure and functions of the higher plants or their organs, in all questions about these lower plants, the cell, its character, structure, and power, is all in all. We can never lose sight of the fact that a single cell is their origin and their conclusion; and that however they may arrive in the course of their life to a multicellular structure, the individual cell is ever before us isolated or in association. You will thus easily understand that before I can in any clear and comprehensible way explain the structure of Urococcus, which is the most simple of multicellular plants, I must at least in some brief way refer to those essential characteristics of the individual cell which prepare the way for the early complex form, first of Glœocapsa and then of Urococcus.

I have therefore to ask you to consider with me *a cell*, what it is, and where its power resides? I speak of a cell such as Glœocapsa, that has, so to speak, individualised itself; for cells that go to form territories of cells in higher structures do not fall to be spoken of here. A cell, then, is a central power, with a periphery for limitation; the cell-wall is this periphery and is its boundary, but the power that built up the cell wall resides within it, and directs and controls all the changes that take place within it. The circumscription of this power or force within the limitation of a narrow boundary conserves and intensifies that high power of action which we find to abide within the cell—a power of action with which the same volume

of force in a wider field would be totally incommensurable. The power is relational to the conditions under which it is exerted. The cell of Glœocapsa, then, is a closed vesicle, containing forces that have had the power to individualise themselves. Simple cells in isolation are very various in their forms. Spherical, oval, and discoidal are the more common in the Palmellaceæ. In these free cells the form assumed is due to the central power, subject only slightly to circumstances of environment, for the circumstances do not exert anything like the same controlling power as when cells are developed as tissues within a circumscribed space. I mention this trite fact in regard to cells because it explains the altered forms which the cells in Glœocapsa assume in the course of their development. Except in the youngest state, all species of Glœocapsa are polydermatic—that is, they are many-coated, consist of cells within cells, the interior being the younger. Such forms have the appearance of being ringed cells, but they are cells within cells, each with a dense periphery; the central or nuclear portion is coloured, and is made up of very minute bodies, closely aggregated, and an amorphous coloured substance, either green or red. Under the highest powers of the microscope these minute corpuscles have a considerable amount of free motion, and these actions are, no doubt, very important in regard to the developmental processes of the plant: they do not all seem of one character, nor have they the same appearance; they are more or less dense, variously shaped, differently coloured, refract light differently, and are not all equally affected by chemical agents. In all probability they fulfil different purposes in the vital economy of the plant, some being secreting bodies, some vegetative or formative, some reproductive, and so on. The relative proportions of these elementary parts are not always the same in cells otherwise apparently alike, and this may serve to explain how, in these structures, comparatively simple as they are, there may be a considerable difference in form, size, number of contained cells, and especially of power of reproduction.

I find, for instance, that many of these plants which in their natural habitat produce sporangia freely, when placed under the artificial conditions of my germinating house,

vegetate freely enough, repeat one another without failure in apparent healthy condition, yet sporangial cells are produced only very sparingly, if at all; and I take it to be that my plants in their artificial circumstances do not form the reproductive nuclear vesicles, which are the necessary preliminary to the production of sporangia. Karsten long since recognised the fact that the small vesicles contained within the large central coloured cell or nucleus were not all of equal value in the vital economy of the cell, and my observations go to prove the truth of Karsten's views. Many species of Glœocapsa closely resemble in their maturity the form and structure of the very young Urococcus. There is a true generic distinction between them, however; the one seems to start from the point of growth where the other leaves off; but in some circumstances the aspect is very much the same, so much so, that one may easily be taken for the other. This arises, for instance, when from any cause the consistence of the cell contents in a Glœocapsa is more dense and firm than in ordinary cases, and the cell of the second degree is thus unable to free itself from its environment, and develops its new cell through the ruptured portion of its primary cell, remaining in connection with it. In Glœocapsa this procession seldom goes on beyond the superposition of one cell on another, but I have seen it in some cases go on for three or four generations of cells. Although this condition may be abnormal in some species, I think it is a normal condition in others. I have a specimen under a microscope here which I found lately in Arran, and had named it for my own cabinet *Urococcus brevis;* but subsequent study enabled me to know that I had really a Glœocapsa to deal with, and that it differed in important particulars of structure and growth from Urococcus. Still the transitional stages from the one genus to the other are by delicately beautiful gradations which serve to give a high interest to the investigation of them, and heighten that to be derived from the examination of new species.

This drawing and diagram of *Glœocapsa quaternata*, prepared for me by the skill and care of Mr Neil Stewart from a preparation under one of the microscopes, will serve to illustrate the structure and mode of vegetative increase of th

genus.* It is a large species, and exhibits all the processes very clearly. The ruptured outer cell and the emancipation of the younger cells are also well marked. The number of cells shown by these rings corresponds with the number of highly refracting centres—nuclei, I suppose, so at least it appears to me; for although sometimes there is a ring more to be seen than there are nuclei to be observed, I take it that the other nucleus would be found on the under side of the central coloured mass in which they are all immersed. Referring now to the drawing, these broken lines and the delicate membrane attached to them are the remains of a ruptured cell within which these two and these four cells had their origin, just as these two have their origin within this one, or these two within this one. In the course of their growth they have burst the cell that was at one time sufficient to contain them, just as these will burst this cell at their maturity. The Palmellaceous Algæ differ very much in regard to the density of the gelatinous mass. In Palmella and Palmoglœa it is very thin, soft, and diffusive, and offers little resistance to the development of those plants; but when we arrive at the higher structures of Glœocapsa we find a much more firm and resisting substance, and the cell has a dense periphery or cell-wall. Still, even in Glœocapsa the new young central forces have power to burst their environment, and the young cells free and isolate themselves.† Now one step higher in the scale of development on the same line of advancement and we reach Urococcus. As Glœocapsa stands above Palmella, so does Urococcus stand above Glœocapsa. In Urococcus the nucleus of the second degree develops its cell within the primary cell,

* This paper was illustrated by a large number of microscopical preparations, and by enlarged drawings of Glœocapsa and Urococcus.

† The processes of forcibly tearing the cell-membrane as a means of the contained young cells freeing themselves have been referred to by Professor Braun under the head of Destruction of the Cell, in his work "On Rejuvenescence in Nature." Glœocapsa afforded him, among many others, an apt illustration of the truth, that the old gives place to the new—that youth superimposes itself upon age. In the same work too, we have a thorough recognition of a specific and individual vital unity running through all the changes of form, and also that the investigation of development in the smallest as in the largest circle, is the most profitable and most promising field of action in natural history.

but it does not quit the primary cell and become free, neither does the primary cell soften and diffuse itself, but the cell of the second degree having been developed within the primary cell on a higher plane than the centre of its origination, remains in attachment to the first, but rising somewhat above it. The cell of the third degree is evolved within the cell of the second degree, and remains in attachment to it and this evolution of new cells; a fourth within the third on a higher plane; again a fifth within a fourth, and so on until it may reach a hundred cells standing one on another, each individual cell not exceeding in height from $\frac{1}{18000}$th to $\frac{1}{20000}$th of an inch, and yet in the aggregate forming a stem $\frac{1}{80}$th of an inch high. The lines of striation indicate the successive cells; they are compressed considerably; their diameter is much greater than their depth, and when compressed, their depth is not greater than I have stated. It is the nature of the plant to grow in densely clustered masses, and they rise from their gelatinous substratum like a pillared forest. Individual plants are often united by a very delicate connecting filament, from which they rise in the same way as Fungi do from their Mycelium or Mosses from the Proembryo. I can say nothing more about this now, than that it connects together a few individual plants. Further observation may enable us to speak with more determination in regard to its relation to the stem. The colour of the nucleal portion gives colour to the mass; it is sometimes of an exquisite æruginous green, sometimes a very pellucid white, and sometimes of roseate hue. Hassall says they are blood-red, and I have found some of that colour, but the principal portion of my gatherings are green. I have here on the table a mass containing Urococcus which I gathered in one of the old sea caves upon the raised sea beach on the west coast of Arran.

The following Letter from Professor Lawson was read:—

DALHOUSIE COLLEGE,
HALIFAX, N.S., 21*st June* 1865.

DEAR DR BALFOUR,—Within the last few years a good deal of interest has been shown among botanists in reference

to the occurrence of *Calluna vulgaris* on the American continent and islands. Last winter I sent to you a specimen which I had collected in the autumn of 1864 in Cape Breton Island, and I have now the pleasure to add another habitat, not from personal observation indeed, but of the authenticity of which there is no room for reasonable doubt.

It may be well, perhaps, to recall the chief facts in reference to Calluna in America. The earliest notice of its occurrence, Dr A. Gray has pointed out to be that of Sir William Hooker, in the "Flora Boreali-Americana" (Index, vol. ii. p. 280), where it is stated, "This should have been inserted at p. 39, as an inhabitant of Newfoundland, on the authority of De la Pylaie." It was subsequently supposed by many botanists that Pylaie, or some one else for him, had made a mistake, and the common teaching of botanists was that true heaths were limited to the Old World.

In the year 1861, Dr Gray announced the unexpected discovery by Mr Jackson Dawson of heath in Tewksbury, Massachusetts. The place was indicated to me by Professor Hitchcock, jun., in passing through Massachusetts by rail; but I had no opportunity of examining the spot. It was suspected that the heath had been planted there at some remote period, and continued to flourish. There is, indeed, in the Boston Society's Proceedings an elaborate paper by Mr Sprague, in which it is strongly argued that no native heath had ever been found in Newfoundland or on the American continent.

In November 1863, at a sale of the Linnean Society's collections in London, Mr Watson bought a parcel of plants in which were found two flowerless branches of Calluna, identical with the heath of the British moors, and labelled, "Head of St Mary's Bay—Trepassey Bay also, very abundant—S.E. of Newfoundland, considerable tracts of it." Evidence thus seemed to accumulate, but was still imperfect. Personal inquiries among Scotch colonists acquainted with Newfoundland afforded no farther information.

In September 1864, being on a tour in Cape Breton Island, carrying out the provisions of an act that had been passed during the previous session of our Parliament for the encouragement of agriculture, I learnt accidentally that a

Scotchman, Mr Robertson, who had been in business in Mexico, had removed to Cape Breton some ten years ago, and, on his arrival, was astonished to find heather growing on his newly purchased property at Ulston, St Ann's Bay. When on Boularderie Island, I found I was no great distance from St Ann's, being separated merely by some ranges of wooded hills over which there were no roads. Starting early in the morning I succeeded in threading my way over to St Ann's, collecting in peat bogs on the hill tops some interesting plants; among others, *Rubus Chamæmorus* and *Sarracenia purpurea*, side by side in the same swamp; also, *Tormentilla officinalis*, a common European plant, which does not seem to have been observed before on this continent. The heather was growing in a wet place (or "swale") where spruce trees had been growing, and looked quite healthy, but a good deal eaten down by cattle. The plant is rather more lax in habit and greener than usual in Scotland.

About the same time Mr Richardson of the Canadian Geological Survey had collected the Calluna in Newfoundland, and brought specimens.

On Saturday last, Miss Lawson, a young lady attending my botanical class, brought to the class-room a specimen of *Calluna vulgaris* (agreeing in every respect with the Cape Breton plant), which had been collected near Dartmouth, in the county of Halifax, in August 1850. It formed part of a small collection of plants gathered near Halifax, and the label reads, "Heath picked by Georgie at Mount Edward, Aug. 1850." I enclose a portion of the specimen, and shall be glad if you will place it in the University Herbarium, in case we may not succeed in re-discovering the plant in Nova Scotia proper. The Halifax habitat is interesting in several points of view. It and the Massachusetts one (doubted by Sprague) are the only stations on the American continent; and the former serves to connect the latter with the island habitats of Cape Breton and Newfoundland, which latter, on the other hand, connects in some measure (though distantly) through Greenland, Iceland, and the Azores, with the great heath centre of Northern Europe.

We are very apt to lose our Calluna and other rare plants, in consequence of the frequent forest fires that sweep over

the country.—With kind regards, I am, dear Sir, yours truly,

GEORGE LAWSON.

Professor Balfour, M.D., F.R.S., &c.

Professor Balfour noticed several rare plants lately collected near Edinburgh, including *Schœnus nigricans*, Largo Links (Mr Sadler), *Carex incurva*, Largo Links (Mr Gilbert C. Stewart).

A note was read from Mr G. W. R. Hay, in which he referred to the tendency this season of ternate-leaved plants to produce four leaflets, as seen in clover, laburnum, strawberries, &c.

A notice of the death of the Hon. John Wynne of Hazlewood, Sligo, was laid on the table. He died suddenly on 20th June 1865, while on a visit to the Bishop of Tuam. He was Under-Secretary for Ireland under the Government of Lord Derby, and was then M.P. for Sligo. Mr Wynne became a Fellow of the Society in 1839.

Dr Kirk presented specimens of *Cheilanthes Kirkii* from Africa, and seeds of a new Banana, called *Musa Livingstonii*.

Mr M'Nab placed on the table a collection of interesting alpine plants and ferns, also plants of the rat-tail radish (*Raphanus caudatus*) from Saharunpore, with very large pods.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

9th November 1865.—Dr ALEXANDER DICKSON, President, in the Chair.

The following Donations to the Library were laid on the table :—

Report on Forest Administration in Central India for 1862–63. By Dr Cleghorn.—From the Author.

Report of the Conservator of Forests for India, 1863–64.—From Dr Cleghorn.

Report of the Smithsonian Institution, Washington, for 1863. —From the Institution.

Report of the Boston Society of Natural History, 1865.—From the Society.

Journal of the Linnean Society (Botany), Vol. IX., Nos. 33–35. —From the Society.

Annals of the Lyceum of Natural History of New York, Vol. VIII., Nos. 1–3.—From the Lyceum.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft zu Zürich, 1864.—From the Society.

Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlande und Westphalens, 1864.—From the Natural History Society of Bonn.

Ueber einen Uebelstand in der Botanischen Nomenclatur, von François Crepin.—From Professor Braun, Berlin.

Verhandlungen des Botanischen Vereins für die Provinz Brandnburg und die angrenzenden Lä nder, Berlin, 1864.—From the same.

Deux Ascensions Scientifiques au Mont Blanc. Par Charles Martins.—From the Author.

La Végétation du Spitzberg comparée à celle des Alpes et des Pyrénées. Par Charles Martins.—From the Author.

Report of the Vancouver Island Exploration Committee, 1864. —From Mr Robert Brown.

Journal of Mr Robert Brown, botanical collector to the British Columbia Botanical Association.—From the Association.

On the Nature and Diagnostic Value of Raphides and other Plant Crystals. By George Gulliver, F.R.S.—From the Author.

Series of the Annual Statistics of the Botanical Class in the University of Edinburgh.—From Professor Balfour.

The following additions to the University Herbarium were announced:—

From Rev. W. Allport Leighton, Shrewsbury—Specimens of Lichens collected by Sir John Richardson, in 1826, in the Arctic Regions.

From Henry Boswell, Esq., Oxford, per Dr Gainer—Rare English Plants.

From David A. P. Watt, Esq., Montreal—Specimens of *Aspidium fragrans*, *Woodsia ilvensis*, *W. glabella*, and *W. alpina*. Referring to the latter species, Mr Watt says—"I collected this plant sparingly this summer in the same localities as the other Woodsias, which I now send; and my present idea is, that we must again elevate *W. glabella* to a good species, and reduce *W. alpina* and *ilvensis* to one under Michaux's name of *W. rufidula*."

From J. Clarke, Esq.—Specimens of *Erucastrum inodorum*, collected near Wendon, Essex.

From N. I. Fellmann—Plantæ Arcticæ Exsiccatæ, consisting of 370 Species.

From Sir William Jardine—Specimen of *Nuphar pumila*, collected in the Black Loch, near Sanquhar.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Mrs Millar—Fiji Woman's Dress, and Cake of Maple Sugar.

From Colonel R. L. Playfair—Specimens of Gum Copal from the East Coast of Africa. Colonel Playfair writes—"The larger specimen is the so-called fossil gum, which is obtained by digging about three feet below the surface; the smaller is what is called by the merchants 'Jackass' (corruption of *chakazzi*, meaning copal), and is said to be recent."

From Dr Grierson, Thornhill—A Series of Sections of Woods grown in Nithsdale.

From Dr Landers—Twisted Stems of a Plant from Cuba.

From Mr Pince, nurseryman, Exeter—Cones of *Picea Nordmanniana* and *Wellingtonia gigantea*, produced in his garden.

The President delivered the following Opening Address:—*

Gentlemen,—Before vacating this chair, which I have had the honour to occupy during the past session, it devolves upon me to make, as is the custom in this Society, some remarks, having the double character of an opening address on our entry upon a new session, and of a valedictory one as regards my term of office.

I have, in the first place, to express anew my thanks for the honour which you conferred upon me by your suffrages, and the gratification which your implied good opinion has afforded me. I have only to regret that, from my residing for the most part in the country, it has not been in my power to attend our meetings with the regularity which I could have desired.

I am able, as most of my predecessors in office have been, to congratulate the Society on its progress and prosperity. I have to report a decided increase in the number of new ordinary members during last session as compared with the previous one. The only drawback to our gratification in this respect is the thought, naturally associated with it, of our obituary list, a list in which I have to record the names of some who stood in the foremost rank among the cultivators of our science. Regarding the additions to our number, the Society has been reinforced by nineteen ordinary members, which, when compared with the ten of the previous session, is a gratifying indication that an interest in botany is decidedly on the increase around us. We have also added the names of two Continental botanists to our list of foreign members.

As to our work of the past session, you will observe from our volume of Transactions now published, that, although the result is of somewhat smaller bulk than usual, there has

* It may here be stated that, since its delivery, several alterations and additions have been made upon this address, which was somewhat hurriedly prepared.—A. D.

been no lack of important and interesting matter brought under our notice.

Among the papers read during last session, I may allude to the following:—On new species of Diatoms from the South Pacific, by Dr Greville, consisting of a description of new forms, and illustrated by some of those exquisite delineations with which Dr Greville has from time to time enriched our volumes. Other papers on cryptogamics have been furnished by Mr Jenner and Dr Lauder Lindsay. You will remember with pleasure the beautiful preparations and drawings with which Mr Jenner illustrated his paper on *Urococcus*, and it is to be regretted that some of the drawings have not made their way into our Transactions. Dr Lindsay's paper is on New or Rare Cryptogams from Otago, New Zealand, in which he calls attention to the more remarkable forms which he collected when there. We have another paper from Dr Lindsay on the flora of Otago, in which, among other interesting details, he alludes to the way in which a number of introduced European plants are struggling successfully with the native species, and threatening to extinguish them. From Mr More we have a note on the discovery of *Neotinea intacta* in Ireland. At a subsequent meeting, living specimens were received from Mr More, so that we may hope to see this interesting orchid in flower next season.

On local botany we have had communications from Dr Balfour on excursions to Loch Lomond, &c.; from Mr Naylor, on plants collected by him in the south-west of England; and an interesting paper by Mr Trimen on the flora of the New Forest.

As regards plants more immediately useful to man, we have had a number of important papers, viz.—Reports on Chinchona cultivation—at Darjeeling, by Dr Thos. Anderson; at the Nielgherries, by Mr M'Ivor; and at Pitayo, New Granada, by Mr Cross. A report by Mr Jameson on the government tea factories and plantations in the north-western provinces of India. Several notices of vegetable products, by Professor Archer; and one by the Lord Provost, Mr Lawson, on Esparto (*Macrochloa tenacissima*), a grass which is now largely used in the manufacture of paper.

From Mr M'Nab, besides his periodical reports on the

state of vegetation at the Botanic Garden, we have an interesting paper on some exotic Coniferæ raised from seeds ripened in Britain, in which he calls attention to the very frequent debility exhibited by such seedlings, and suggests that it would be better for cultivators to trust more to the original method of propagating by cuttings and layers, rather than expose themselves to the disappointment which the seedlings referred to may cause. From Dr Cleghorn we have had interesting papers on an excursion from Simla to some valleys draining into the Jumna River, and "Supplementary Notes upon the Vegetation of the Sutlej Valley," containing much important information. We had also some interesting observations from Dr Brandis, Inspector-General of Forests in India, on the Conservation of Indian Forests.

We are again indebted to Mr G. M. Lowe for more or less condensed abstracts of a number of French papers on various subjects.

I regret to record the deaths of two honorary members—Sir W. J. Hooker and Dr John Lindley; of four ordinary members—Drs Falconer, Balfour Baikie, and Dickinson, and the Hon. John Wynne of Hazelwood; and of one associate, Mr John Robertson.

Sir William Jackson Hooker, K.H., F.R.SS. L. & E., &c., was born at Norwich on the 6th July 1785. He was educated at the High School there, under the tuition of the Rev. Dr Foster. Coming, in 1806, into possession of considerable estates left to him by his godfather, William Jackson, Esq., he resolved to devote his life to travelling and scientific pursuits. At first his scientific predilections had been for ornithology and entomology; but his discovering the rare moss *Buxbaumia aphylla* became the occasion of his being led, by Sir J. E. Smith, to commence the study of botany, which thenceforth became his sole aim. Between 1806 and 1814 he made various botanical expeditions to Scotland and its islands, and to France, Switzerland, and Iceland, and became acquainted with many of the principal scientific men in England and on the continent. In 1815 he married the daughter of Dawson Turner, Esq., a banker in Yarmouth, and a good botanist, and settled at Halesworth, in Suffolk. Here he laid the foundation of his now un-

rivalled herbarium, and of the very extensive series of botanical works which have made his name famous wherever botany is studied. In 1810–11 he had made extensive preparations for accompanying Sir R. Brownrigg to the then little known island of Ceylon, a plan which was frustrated in consequence of the disturbed state of the island. For this purpose he sold his estates, the proceeds of which, having been injudiciously invested, ultimately decreased much in value. This diminution of income, although unfortunate in some respects, ultimately led to his accepting, in 1820, the Professorship of Botany in Glasgow, and, in 1841, the appointment of Director of the Kew Gardens, and, in all probability, is to be regarded as the great element in his career, increasing the opportunities of which he made such unwearied use, resulting in the mass of invaluable works and collections which he has left as monuments of his skill and energy. It would carry me much beyond the limits which I have prescribed to myself were I to detail the multifarious ways in which Sir W. Hooker has advanced the science of botany, by his writings, by his unremitting exertions towards stimulating botanical research throughout the world, &c., &c. He was knighted by William IV. in 1836, on the honour being for the second time offered him, in consideration of his scientific labours and the great services he had rendered to botany. He died at Kew on the 12th August 1865, in the 81st year of his age, after a short illness, of a complaint in the throat, then epidemic in that place. He became a Fellow of the Wernerian Society (since incorporated with our own) in November 1809, and was elected an honorary British member of our Society in December 1846.

The name of John Lindley, Ph.D., F.R.S., has for many years past been intimately associated with the progress of botanical science. He was born at Catton, near Norwich, in 1799, and was the son of a nursery-garden proprietor there. His first literary efforts, after devoting much of his early youth to the practical study of the science of botany, were the translation of Richard's "Analyse du Fruit," and the contribution of some papers to the Transactions of the Linnean Society. After that he proceeded to London, where he was engaged by Mr Loudon to assist

in the production of the "Encyclopædia of Plants." In 1832 he published his "Introduction to Systematic and Physiological Botany," but his *chef-d'œuvre* was the "Vegetable Kingdom," which gives a philosophical and comprehensive view of the structure and uses of the plants of the known world. For more than a quarter of a century Dr Lindley filled the chair of botany at University College, London, and in 1860 was appointed examiner of the University of London. He was Ph.D. of the University of Munich, Fellow of the Royal, Linnean, and Geological Societies, and corresponding member of many Continental and American learned bodies. He was elected an Honorary Fellow of the Botanical Society in 1860. In 1858 he received the medal of the Royal Society in reward of his services to the modern sciences. He died suddenly, of apoplexy, at his residence at Acton Green, near London, on the 1st November 1865, aged 66.

Dr Hugh Falconer was born at Forres in 1808. He studied successively at the universities of Aberdeen and Edinburgh, afterwards proceeding to India, where he held for some time the office of Director of the Botanic Gardens, first at Saharunpore and then at Calcutta. His chief field of study was palæontology, but he was also favourably known as a student of botany and of natural history generally. His scientific memory was remarkable, and the stores of knowledge at his command were so great that those who knew him, speak of his loss as if with him had perished a treasure of information which is not likely to be soon amassed again. It was to information supplied by him that we owe the cultivation of tea in Assam, and it was he who suggested the cultivation of Chinchona in India, which has been attended with complete success. He has published several important botanical papers in the Transactions of the Linnean Society. Dr Falconer returned to this country about ten years ago with shattered health, having spent twenty years in India, and he died in London on the 31st January 1865, aged 55. The cause of his death was acute rheumatism, along with pulmonary congestion and disease of the heart. He graduated in Edinburgh in 1829, and wrote his thesis "On Chorea." He became a Fellow of our Society on the 23d July 1841. Naturalists

in Britain are now subscribing for a memorial of Dr Falconer, which is to consist of a bust and a Natural Science Fellowship in the University of Edinburgh.

William Balfour Baikie was born in Orkney, and prosecuted his medical studies at the University of Edinburgh, where he took the degree of M.D. in 1847. He was zealously devoted to natural science, especially to botany, during the period of his studies at Edinburgh. In 1854 he entered the navy as assistant-surgeon. In 1856 he was appointed to the Pleiad, which had been fitted out for a government expedition to the west coast of Africa, to open up the trade of the Niger. He went on an expedition to Chedda or Tsadda, in Central Africa, and published a narrative of an exploring voyage up the rivers Kwora and Binue (commonly known as the Niger and Tsadda). In 1857, during a subsequent voyage, the Dayspring, an iron steamer, was lost in the rapids at Rabba. This compelled Baikie and his friends to encamp on the neighbouring banks, and finally led to an interview with the Sultan of Sokoto. A vessel was afterwards sent out to the party, and they established a settlement at the junction of the Chedda and the main stream. Dr Baikie carried on his efforts at civilisation for seven years; but his health broke down, and he was recalled at his own request. He was attacked, however, with fever and dysentery at Sierra Leone, and died there on 30th November 1864. He sent to several scientific societies interesting reports on the district of Africa which he visited. He kept an accurate journal of his proceedings, which is now being revised for publication by Dr Kirk. He joined the Botanical Society in February 1847.

Joseph Dickinson, M.D., F.R.S., died at Waterloo on 31st July last, at the age of 54. He had acted for many years as consulting physician in Liverpool, and had acquired high eminence. His success was due probably not more to his scientific attainments than to his high sense of professional rectitude and honour, and a constant regard for the reputation and position of those with whom he was called upon to act. He was fond of science, more especially of botany. He was the author of a History of the Flora of Liverpool, and contributed papers to several scientific journals. He was President of the Liverpool Literary and Philosophical

Society, and of the Royal Institution. In the course of his professional career he filled the offices of Physician to the Dispensaries and to the Fever Hospital, Lecturer on Materia Medica, and on the Practice of Physic, as well as Physician to the Royal Infirmary. He was a member of the British Medical Association, and President of the Lancashire and Cheshire branch. He became a Fellow of the Botanical Society in November 1838.

The Hon. John Wynne of Hazelwood, Sligo, was Under-Secretary of State for Ireland under the government of Lord Derby, and was then M.P. for Sligo. He died suddenly on 20th June 1865, while on a visit to the Bishop of Tuam. He was a liberal encourager of horticulture in Ireland. He joined our society in 1839.

Mr John Robertson was born in Perthshire, and acquired a taste for botany in Kinfauns Castle Gardens, under the late Mr Campbell, who was an enthusiastic lover of plants, and an intimate botanical companion of G. Don of Forfar, &c. When a journeyman gardener Mr Robertson went to Kew, where he was much esteemed by the then director, Mr Ayton. After leaving Kew he married Mr Campbell's daughter, and ultimately succeeded him in his situation at Kinfauns Castle, where he spent the greater part of his life. Some years since he came to Glasgow, where he prepared for the press a "Flora of Perthshire," which was never published from lack of subscribers. He was one of those gardeners (who are becoming scarcer and scarcer) who knew both native and cultivated plants well. He was elected an associate in April 1863. He died at Glasgow, of stomach complaint, on the 24th March 1865.

Having thus briefly considered the events of our last session, I think I may not unprofitably engage your attention for a little with a few considerations upon a matter in vegetable morphology, which has been keenly discussed by botanists within the last few years, and which I have already brought, in some measure, under the notice of this Society. I allude to the question as to the constitution of the female flower in the Coniferæ and their allies.

This question had, as you are aware, been for long supposed by most botanists to be satisfactorily settled, although it may be doubted whether the popularity of the received

doctrine was due so much to its intrinsic plausibility as to the authority of its learned propounder, Robert Brown.

In bringing forward his theory of naked ovules in the Coniferæ and their allies, Brown* founded his argument mainly on two grounds,—

1*st*, The fact of the investing structure being perforated, and permitting the pollen-grain to pass bodily on to the surface of the nucleus.

2*d*, The assumption that a naked nucleus is too simple a structure to be considered as an entire ovule.

The perforation of the investing structure, permitting the direct passage of the pollen-grain to the surface of the nucleus is a well-established fact; but it is not possible to maintain the assumption that an ovule cannot consist of a naked nucleus, as botanists are now familiar with ovules reduced to naked nuclei.

In 1860 Baillon published his observations on the development of the female flower in various Coniferæ and Taxaceæ, a translation of which I had the pleasure of submitting to this Society. He forcibly combated the doctrine of Robert Brown as to these flowers, and argued that, as in all the species which he examined, the so-called "integument" of the "ovule" appeared in the form of two primitively distinct semilunar elevations, these flowers really consisted of bicarpellary ovaries, each containing a single basilar ovule reduced to a naked nucleus. Baillon's observations were repeated and confirmed on *Pinus* by the late Professor Payer, beyond all dispute the highest authority on questions relating to the development of floral organs. I myself examined the development of the so-called "ovule" in *Dammara australis*, and my results essentially corresponded with those of Baillon and Payer. Thus as to the so-called "ovular integument" of the Coniferæ, there can be no doubt that in many cases, at least, it appears at first in the form of two semilunar elevations. Since the publication of Baillon's paper, his views have been assailed by Caspary, Eichler, and Dr Hooker, all of whom support the doctrine of Robert Brown. I shall, in the following remarks, chiefly consider the statements of Dr Hooker, contained in his most valuable and interesting paper on the recently-dis-

* Appendix to King's Voyage.

covered Gnetaceous plant *Welwitschia mirabilis*, where the principal arguments in favour of Brown's theory are set forth with great distinctness.

To avoid misconstruction, I shall quote in full the principal passage in Dr Hooker's paper relating to the question under consideration. Regarding the so-called "ovule" of *Welwitschia*, he says—

"There is nothing in the development of this ovule that favours the opposite theory, that the integument of the nucleus in gymnospermous plants is of carpellary origin, except the singular form and relative position of that organ in the hermaphrodite flower. In position, texture, structure, and development it entirely resembles the coat immediately investing the nucleus in all other Gymnosperms; like these, and unlike carpellary organs, it is entirely devoid of vascular tissue in its substance, and of conducting tissue in its styliform prolongation; unlike a carpel, it rises symmetrically round the nucleus, and in the hermaphrodite flower presents a symmetrical terminal disc, and it ceases to grow long before the maturation of the seed; and, still more unlike a carpel, it is carried up with the growing seed, till its base is on the apex of the latter. In all these respects, except in the long styliform process, it accords with the inner ovular integument of phænogamic plants, which, indeed, have not unfrequently tubular orifices prolonged beyond the nucleus, though not so far as that of *Gnetaceæ*.

"To these considerations must be added that of the exterior integument of Gnetum, which is as clearly an appendage of the ovule as the interior, but which must be considered to be either staminal or a production of the disc, if the inner coat is considered as carpellary.

"Lastly, ovular integuments are singularly uniform in their structural anatomy, which seldom deviates from one common type; and in the normal condition of the ovule it is devoid of appendages, or of other external or internal characters whereby those of allied species, or even genera and orders, can be distinguished from one another. I am not aware that a single natural family or genus of Angiosperms presents any structural peculiarity of the outer or inner coats of its ovule; on the other hand, the carpel is, of all the floral whorls, one of the most various; and, as often happens with other organs, the more reduced it is, and the more it deviates from the foliar type, the more liable it is to vary; whence it is all but inconceivable that the ovular integument of Gymnosperms should be carpellary, and yet constant in structure.

"If, then, we were to assume the ovular integument of Gynosperms to be carpellary, we must admit, first, that it has neither the form, structure, nor functions of an angiospermous carpel; secondly, that it has those of an angiospermous ovular coat; and thirdly, that while the carpel is a singularly varying organ in the genera and even species of Angiosperms, it is a singularly uniform one in those of Gymnosperms." *

* "On Welwitschia, a new Genus of Gnetaceæ," Transact. Linn. Soc. London, vol. xxiv. pp. 30, 31 (1864).

The different points here referred to, I shall take up separately.

1*st*, As to the non-vascularity of the investment of the nucleus in the Coniferæ, &c. I am unable to see how this should be supposed to constitute an argument against the carpellary view. That the female flower of the Coniferæ is of a very reduced type cannot be doubted, whatever view be taken of its nature; and botanists are already acquainted with non-vascular ovaries in plants where the female flower is of a simple type. I refer to the remarkable family of the Balanophoraceæ, regarding which I shall quote from Dr Hooker's Memoir on that order. "In all the above-mentioned plants," he says, "the cellular tissue of the ovary is very loose, consisting of oblong utricles usually furnished with cytoblasts, and without any vascular tissue in its walls (except in the style of *Cynomorium*): there is, however, a manifest approach to vascular tissue in the woody cells of the superior perianth of *Thonningia*, and perhaps also of *Langsdorffia*."*

The non-vascularity of the ovaries of Balanophoraceæ appears to me to be a fact of great importance, for it must, I think, be attributed solely to the lowness of type of the female flower, and not to any general deficiency in the vascular system, which in many of these plants appears to be well developed.

2*d*, As to the want of conducting tissue in the supposed style. This is, of course, tantamount to the want of a proper stigmatic apparatus. It is to be observed here that the absence of a stigma, although, no doubt, remarkable, can be held to indicate the absence of a carpellary investment, only on the assumption that the *essential* function of a carpel is to develop a stigma, a position which is very far from being proved. On the contrary, organogenic observation seems to lead to the conclusion that the essential function of the carpel is to protect the ovule or ovules, either by forming the walls of the ovary, or by roofing it in when the parietes are formed by the receptacle, as in inferior ovaries. Organogeny has shown that the stigma is a development sometimes of the extremity of the carpel,

* Dr J. D. Hooker "On the Structure and Affinities of the Balanophoreæ." —Transact. Linn. Soc. Lond., vol. xxii., p. 17.

sometimes of that of a placental process, and that, therefore, it cannot be viewed as, in any sense, a necessary or essential characteristic of a carpel. Although physiologically important, the stigma must, like several other structures in the vegetable kingdom, be looked upon as without morphological significance; just as a *tendril*, as such, is without morphological significance, since it may result from the modification of very different parts.

The absence of a stigma cannot, I imagine, be construed or constrained to indicate anything beyond what must be admitted as an ultimate fact, viz., that the coniferous pollen-grain is so constituted as to be able to dispense with a stigma. At the same time, however, it must not be forgotten that although, physiologically considered, stigmas do not occur in the Coniferæ and their allies, yet, morphologically, there is a manifest tendency towards their formation in some cases; for example, in the papillose lobes of the so-called "integument" of *Abies*, and, as Dr Hooker has shown, in the expanded stigma-like apex of the abortive female organ in the staminate flower of *Welwitschia*.

3*d*, Regarding the objection that the supposed carpellary investment in Welwitschia rises symmetrically round the nucleus, I may quote some very pertinent remarks by Dr Baillon, from his "Mémoire sur les Loranthacées." Speaking of the genera *Santalum* and *Thesium*, he says—

"It is not uninteresting to remark the difference, at the beginning, between the carpellary (appendiculaire) portion of the gynœcium in two plants, otherwise so closely allied by all the characteristics of their organisation, as *Santalum* and *Thesium*. In the former, the summits of the carpellary leaves are free from one another; in the latter, they are fused into a single and perfectly entire annular cushion. Their nature is, however, the same in the two genera; and this shows the error of those botanists who deny the carpellary origin of an ovarian enclosure (enceinte ovarienne), solely because they see, or believe they see, it developed in the form of a continuous ring."*

In the Primulaceæ, the carpellary development of which Baillon compares with that of *Thesium*, the ovary often, if not always, arises in the form of an entire symmetrical annulus around the centre of the flower.†

* Adansonia, vol. ii. p. 346.

† It is almost unnecessary to multiply examples of carpellary *annuli;* but I may quote the following from Lindley's Vegetable Kingdom, p. 148:—"Mr Griffith has remarked that, although the difference between the vegetable

4th, As to the objection that the supposed carpel in *Welwitschia* ceases to grow before the maturation of the seed, I have to state that although such a phenomenon in carpels may be unusual, it is hardly without parallel. In *Cuphea* the placenta, as is well known, becomes developed so much out of proportion to the carpellary investment that the wall of the ovary becomes ruptured, and the carpels not only cease to grow, but actually wither, before the maturation of the seeds.*

5th, Dr Hooker remarks that "still more unlike a carpel, it [the investment of the nucleus] is carried up with the growing seed till its base is on the apex of the latter." To make this matter a little clearer, I shall quote from another part of Dr Hooker's paper. Speaking of the changes taking place in the "ovule" of *Welwitschia* after fertilisation, he says—

"The nucleus develops rapidly in all directions, but the parts above the embryo-sac grow less than those below it; and as the greatest increment of all takes place at the very base below the level of the insertion of the integument, the latter is carried up, and assuming a higher and higher relative position as the seed ripens, is found at last towards the apex of the seed. This mode of ovular development is common, in a greater or less degree, to all Gnetaceæ, Cycadeæ, and to many Coniferæ."†

On the supposition that the investment of the nucleus in *Welwitschia* is carpellary, this phenomenon must be regarded as in some respects analogous to the formation of an inferior ovary, except that it is not the *ovarian cavity* here which becomes inferior or half-inferior, but the *ovule* itself. The receptacle in both cases becomes cup-shaped: in the true inferior ovary, however, the receptacular cup has a free internal cavity, while in the case of what may be termed the *inferior ovule*, the receptacle only becomes cup-shaped by accommodating itself to the developing base

carpel leaf and the vegetable ovulum is in general sufficiently apparent, an exception has appeared to him to be presented by Naias, in which the future pistil seems to be derived from an annular growth round a central body, which subsequently becomes the ovule."

* It might perhaps be worth while to institute a few special investigations as to whether, in some plants with inferior ovaries, the carpellary portion of the gynœcium (the free part of the carpel of those who believe in adherent calyx-tubes) does not cease growing before the maturation of the fruit. I suspect that in some cases it will be found to do so.

† Hooker, *loc. cit.* p. 32.

of the ovule, and has thus no free internal surface. Such an arrangement as I have above described, strange as it may at first appear, is not without parallel in other Phanerogamia. In the Loranthaceæ, which in certain respects present strong analogies to the Coniferæ and allied families, we have, I believe, some true examples of *inferior ovules.* I would refer to Hofmeister's observations on *Loranthus* and *Viscum*, where, in *Loranthus*, he figures the chalaza as considerably below the level of the junction of the carpels with the slightly developed "superior" or free portion of the ovule ;* and where, in *Viscum*, he speaks of the embryo-sacs insinuating themselves inferiorly "among (entre) the parenchymatous cells of the axis of the ovary."† The term "inferior ovule," which I have here employed, is by no means to be regarded as a new one ; for Schleiden, in his "Principles," although at the time ignorant of the existence of carpels in *Viscum*, which Hofmeister was the first to point out, was correct in fact, that the term "*gemmula infera*" was applicable here.‡

Dr Hooker alludes to the possibility of the outer coat, or rather outer layer, of the "seed" of *Welwitschia*, below the level of the insertion of the "integument," consisting of an "urceolate prolongation of the axis of the flower," as a view suggested to him by Professor Oliver, and founded in part on "some important considerations suggested by the embryogeny of the Loranthaceæ, upon which Professor Oliver is at present engaged."§ I would here express a hope that Professor Oliver, or any one occupied with the Loranthaceæ, will pay particular attention to the extent to which the base of the ovule in *Loranthus* and *Viscum* imbeds itself in the substance of the floral axis, will ascertain, in fact, how much of the mature, or nearly mature, seed is above the level of its junction with the carpels, and how much below that junction. This will, no doubt, be attended with considerable difficulty, from the early obliteration of the ovarian cavity by the adhesion of the carpels to one another, and

* "Nouveaux documents destinés à faire connaître la formation de l'embryon des Phanerogames" (Partial translation), Ann. des Sc. Nat., Sér. 4. XII. pl. i. figs. 4 and 5.

† Ib., p. 24 ; pl. iii. fig. 26.

‡ Schleiden's Principles of Botany (Lankester's Transl.), p. 317.

§ Hooker, *loc. cit.* p. 37.

to the surface of the contained naked nucleus; but I should imagine that a very gradual series of flowers in different stages of development would enable one to arrive with tolerable accuracy at the desired result.

Admitting the analogy between the female flowers in *Viscum*, &c., and those of *Welwitschia*, there is one interesting difference between them, viz.—that while the perianth is epigynous in *Viscum* it is hypogynous in *Welwitschia*. In case any one should think such an arrangement as I have supposed in *Welwitschia* a strange one, I would refer to the case of *Nymphæa*, where the ovary, although formed by the receptacle, and inferior as regards the carpels and stamens, is superior in relation to the calyx and corolla.

6*th*, As to the so-called "outer integument" of the "ovule" in *Gnetum*, there can, I conceive, be no difficulty in considering it to be a development of the disc. It is impossible to look upon it as staminal in its nature, since it appears *after* the so-called "inner integument" of the "ovule." This "outer integument" in *Gnetum* was considered by Payer as being a disc.*

7*th*, Regarding Dr Hooker's argument derived from the general uniformity of ovules in anatomical structure, and in external or internal characters, whereby those of allied species, or even genera and orders, can be distinguished from one another, as contrasted with the variability exhibited by carpels, I may remark that, even on the assumption that his statement holds true as to ovules, we have no such remarkable uniformity in the so-called "naked ovules" of Coniferæ and their allies. The general structure of these is, no doubt, cellular; but they differ considerably among themselves in the amount of thickening matter ultimately deposited in the cells of the exterior, some being, at maturity, of stony hardness, others of no remarkable density. Again, as regards appendages or other external characters, there is great variation—for example, the long tubular prolongation of the so-called integument in Gnetaceæ; the expanded stigma-like lobes in *Abies* and allied genera, and their rod-like homologues in *Pinus;* the much reduced condition of the orifice of the "integument" in *Dammara* and *Araucaria;* the free unsymmetrical wings

* Leçons sur les fam. nat., pp. 51, 52.

of the fruit in *Dammara;* the fruit in *Pinus*, where the only wing is the result of a definite desquamation of a portion of the "squama fructifera," &c., &c.

In concluding my remarks on Dr Hooker's paper, I cannot but allude to a speculation which he has advanced, and which is well worthy of consideration by all botanists, whether supporters of Mr Darwin's hypothesis or not, viz., as to the probability of *Welwitschia* (where the apex of the nuclear investment in the abortive female organ of the staminate flower is dilated into a large stigma-like body) constituting an intermediate form between the Coniferæ, &c., and the other Phanerogamia. That *Welwitschia* does constitute an intermediate form between those Phanerogamia which are provided with true stigmas and those which are not, seems to be in the highest degree likely; but is it not much easier and simpler to conceive of this, on the supposition of the investment of the nucleus here being carpellary, than on that of its being integumentary?

Regarding Dr Eichler's paper, there is nothing specially deserving remark beyond the points which I have already discussed. He refers to the Coniferæ as an order where the metamorphoses are "quite uniform and extremely simple;"* but I would only ask the candid observer to study the female cones of *Pinus*, *Dammara*, *Araucaria*, and *Cupressus*, or even to study Dr Eichler's paper, and say whether the metamorphoses are extremely simple or not.

I shall not occupy your time with any lengthened discussion of Professor Caspary's paper. The most important matter which he brings forward is a description of some monstrous Larch cones; but this only affects, I imagine, the question whether the abietineous "*squama fructifera*" is wholly axial, or in part foliar, a point which I do not intend to discuss on the present occasion. The only objection by Professor Caspary to the carpellary view which I shall here refer to is his assertion, that on this view we must admit that the presumed naked nucleus of conifers appears before the presumed carpels. It is true, indeed, that a mammillæform body appears in the first place, before the development of the presumed carpels; but, on the car-

* Dr Eichler "On Gymnosperms." Translation in Natural History Review, April 1864.

pellary supposition, it is inconceivable how the development should proceed otherwise. The young floral axis must appear before it can give origin to carpels, and its most likely shape is that of mammillæform elevation.

Having thus endeavoured to dispose of the principal objections to the carpellary view of the female coniferous flower, I may now briefly indicate some of the facts which may be adduced in favour of it.

Next to the results of organogenic observation, perhaps the most satisfactory argument in favour of the carpellary supposition, is to be derived from the remarkable analogies which the pistils of Coniferæ and their allies would present to those of certain Loranthaceæ. As examples, may be mentioned the occurrence in both families, 1*st*, of solitary basilar ovules, consisting of naked nuclei; 2*d*, of inferior or half-inferior ovules; and, 3*d*, of a plurality of embryo-sacs (*e.g.*, *Viscum*,* *Taxus*,† and sometimes *Pinus*‡). In addition to these analogies, I may mention that Hofmeister has pointed out that, in *Loranthus europœus*, the lower portion of the "pro-embryo" is "composed of four parallel rows of cells, in a manner very analogous to what is observed in the pro-embryo of an Abietinea."§ He has shown, moreover, that in three of these rows the cell-multiplication ceases after a time, while the terminal cell of the fourth alone goes on to the formation of an embryo;‖ and this also, it will be observed, is strikingly like what occurs in Coniferæ, where, of the four parallel rows of cells which the "pro-embryo" presents, only one usually proceeds to the formation of a perfect embryo. In the Coniferæ, however, the development of the "pro-embryo" proceeds considerably further than in *Loranthus*, for the rows of cells ultimately separate from each other, forming four distinct suspensors, at the extremity of each of which an at least rudimentary embryo is formed.¶ Some interesting observations by Baillon, on the analogy between the two families,

* Hofmeister, *loc. cit.* p. 24, pl. iii. figs. 26 and 28.

† Hofmeister on the Higher Crytogamia, &c., Currey's translation, p. 401.

‡ *Ibid.* p. 401 (note).

§ Hofm. Ann. des Sc. Nat. Sér. 4, xii. p. 14.

‖ *Ibid.* p. 14.

¶ Hofm. on the Higher Cryptogamia, &c. pp. 428-9.

are to be found in the memoir from which I have already quoted.*

The ovaries of certain Balanophoraceæ, also, seem to present remarkable analogies, in some respects, to those of the Coniferæ. In *Helosis*, for example, there is a solitary basilar ovule reduced to a naked nucleus,† and two wholly cellular carpels. Hofmeister describes the longitudinal axis of the pedicel in *Helosis* as being occupied by a bundle of tracheæ, "which appear to be the terminations of the numerous vascular bundles of the inflorescence," and his figure represents this bundle of tracheæ as terminating a little below the base of the ovule.‡ It is a remarkable circumstance that neither in this plant nor in *Welwitschia* does the vascular system of the female flower extend beyond the base of the naked nucleus;§ indeed, it would appear to be exact to state that in both plants the vascular system of the pistil is reduced to chalazal vessels.

To conclude, I think I have been able to show that none of the peculiarities of coniferous female flowers are incompatible with a carpellary view of their structure. We have seen that non-vascular carpels, naked nuclei, and inferior ovules occur in undoubted angiosperms. We have seen that, although physiologically considered, stigmas are absent in the coniferous flowers, yet there is, in some cases, a manifest tendency towards their formation. The absence of a proper stigmatic apparatus is probably correlated with some peculiarity of the pollen-grain; but the explanation of such a condition does not seem to be facili-

* Baillon, *loc. cit.* pp. 375–6.

† Hofmeister, Ann. des Sc. Nat. Sér. 4, xii. pp. 56–9. I ought here to mention that Dr Hooker, in his Memoir on the Balanophoraceæ, described *Helosis* as having a *pendulous* ovule. Hofmeister, however, from a more complete organogenic examination, has shown this to be erroneous. Dr Hooker seems to have mistaken the embryo-sac and its contents for the ovule.

‡ *Ibid.* p. 57, pl. vi. fig. 57.

§ It is to be borne in mind that the upper limit of the base of the ovule (nucleus of Hooker) in *Welwitschia* corresponds to its line of junction with the carpellary investment (ovular integument of Hooker); while in *Helosis* the limit of the base of the ovule corresponds to its junction with the receptacula cup, which constitutes the inferior ovary. Thus, while in *Welwitschia* the vascular system of the floral axis extends as far as the base of the carpels, in *Helosis* it only reaches the base of the inferior ovary.

tated by a gymnospermous hypothesis, which at least must be admitted to labour under the disadvantage of being *contrary to analogy.* When such considerations are added to the positive results of organogenic observation, showing the primitive duality of the nuclear investment in a number of Coniferæ, the evidence in favour of a carpellary view appears to me to be so strong as to leave no room for reasonable doubt on the subject.

Since the foregoing was sent to the press, I have seen a review, by Professor Oliver, of Dr Hooker's paper on *Welwitschia* (Nat. Hist. Review, April 1864), and also " Notes on the Loranthaceæ" by the same author (Proceedings of the Linnean Society—Botany—vol. vii. p. 90). From these it will be seen that Professor Oliver has recognised the analogy between the imbedding, or what he terms invagination, of the base of the nucleus in Gnetaceæ, &c., and that in the Loranthaceæ; and in a recent letter to myself, he states his opinion " that this invagination is quite a similar phenomenon in both Loranths and Conifers." Although Mr Oliver and I are thus far agreed, yet, as appears from the review of Hooker's paper above referred to, he does not hold the investment of the nucleus in Conifers and their allies to be carpellary, but is inclined to view it as an axial structure analogous to a disc. Mr Oliver attaches, I think, too much importance to Caspary's argument derived from the irregularly lobed character of the orifice of the nuclear investment, *in the adult state*, of some Abietineæ. I cannot appreciate the weight of such an argument, as opposed to the positive observation, in many cases, of a *regular* lobing of the nuclear investment *at its origin:* for we know that the extremities of carpellary leaves may, in the adult state, be irregularly laciniated, which were entire at their origin—*e.g.*, in *Dionæa muscipula* (Payer, Organogénie, pl. 38, fig. 28).

I. *List of Lichens collected in Otago, New Zealand.** By W. Lauder Lindsay, M.D., F.R.S.E., &c.

The Lichens enumerated below were collected, towards the close of the year 1861, chiefly in the Greenisland district of the province of Otago, New Zealand—a district about five miles southwards of its capital, Dunedin. A few, however, were also collected—

1. In the immediate vicinity of Dunedin itself.
2. In the Tuapeka (Goldfield) district, about 37 miles north-west of Dunedin, and towards the interior of the province (elevation above sea, 1000 to 1500 feet: Geological basis, gneiss—tertiary auriferous drifts); and
3. In the district at the mouth of the Clutha, about 60 miles south of Dunedin, including the vicinity of Finegand station, and the headland known as the Nuggets.

Saxicolous species were collected chiefly on—

1. The Chain Hills (1100–1280 feet: mica slate and gneiss).
2. Saddlehill, including Scroggs Hill (1100–1565 feet: *Apex*—basalts and trap tuffs;† *Base*—tertiary crag, made up mostly of *Ostrea* fragments (Woodburn): tertiary, coarse, quartzose conglomerates, grits and sandstones: talcose slates (Otokia).
3. Stoneyhill (1000 feet: columnar basalt).
4. Kaikorai Hill (1092 feet: basalts).
5. Greenisland Hills and Cliffs (500–600 feet: porphyries and basalts; tertiary, fossiliferous, marine, calcareous sandstones).
6. Ferry Hill, Clutha Ferry (250 feet: slaty basalts and trap conglomerates).
7. Finegand Ranges (250 feet: slaty basalts).
8. The Nuggets (270 feet: slaty basalts and trap conglomerates, associated with fossiliferous strata, apparently of mesozoic age.
9. Anderson's Bay (200 feet: trachytes).

Corticolous species were gathered mostly in various remnants of the primitive forest that once apparently covered

* My friend Dr Nylander, of Paris, did me the favour to examine *the bulk* of my Otago Lichens (all those regarding which there was any doubt as to whether they might be *new* or were already known); and to him I am indebted (in the case of these Lichens) for the determination of the species, as well as the nomenclature and classification, in the following list.

† The traps of Otago are in great measure, if not entirely, of tertiary age.

the whole surface of the country:—which remnants are now extremely limited—and are colonially known as patches of "bush"—

1. Saddlehill Bush.
2. Stoneyhill Bush.
3. East Taeri Bush—in the flat and rich alluvial plain or carse of the Taeri.
4. Greenisland Bush.
5. Various patches of bush in the ravines of the Chain Hills.
6. Water of Leith, about Pelichet Bay, Dunedin.
7. Signal Hill, North-east Valley, Dunedin (1200–1300 feet: basalts).
8. Mount Cargill (2297 feet: trachytes and breccias, &c.)

The forest trees on which they grew were chiefly "Goai" (*Sophora tetraptera*, Aiton) and "Totara" (*Podocarpus Totara*, A. Cunn.), and the trunks affected were more generally decaying or dead than living.

Lignicolous species—affecting fabricated timber, generally more or less aged,—were found chiefly on the fences of stockyards on or near the farm of Fairfield, Saddlehill,—my headquarters for four months.

Muscicolous and *Terricolous* species were collected on the soil (or its decayed vegetation—exposed, dried and withered roots of grasses, mosses, &c.) of the hills, cliffs, ravines, or forests above referred to.

My collection makes no pretension to be considered representative or complete. On the contrary, it is avowedly and necessarily incomplete and limited; it comes from a very small area of the east coast, and from elevations under 1500 feet; and it was made casually in the course of excursions undertaken with very different objects in view. Nevertheless, the field was so new, and comparatively so rich, that it has yielded to casual or superficial collection, as will immediately be seen, as much as 19 per cent. of species or varieties *new to science;* while in addition—small though the collection be in itself, its total reaching only 122 species—it has also extended our knowledge of the geographical diffusion of Lichen-species in the southern hemisphere.

Enumeration of Species and chief Varieties (collected in a condition suitable for their determination).*

Tribe I. COLLEMEI.

Genus 1. Collema.

Species 1. (B†) C. leucocarpum, *Tayl.*

Tribe II. SPHÆROPHOREI.

Genus 1. Sphærophoron.

Species 1. S. tenerum, *Laur.*

Tribe III. CLADONIEI.

Genus 1. Cladonia.

Species 1. (B) C. pyxidata, *L.*
2. (B) C. fimbriata, *Hffm.*
3. (B) C. degenerans, *Flk.*, and
(B) *var.* euphorea, *Ach.*
(B) — haplotea, *Ach.*
— lepidota, *Ach.*
— erratica, *Linds.*
4. (B) C. rangiferina, *Hffm.*
var. pumila, *Ach.*
5. C. aggregata, *Sw.*

Tribe IV. STEREOCAULEI.

Genus 1. Stereocaulon.

Species 1. S. mixtum, *Nyl.*
2. S. ramulosum, *Nyl.*
3. S. corticatulum, *Nyl.*

Tribe V. USNEI.

Genus 1. Usnea.

Species 1. (B) U. barbata, *Fr.*, and
(B) *var.* florida, *L.*
(B) — plicata, *Fr.*
(B) — hirta, *Fr.*
(B) — articulata, *Fr.*

Tribe VI. RAMALINEI.

Genus 1. Ramalina.

Species 1. (B) R. calicaris, *Ach.*, and
(B) *var.* fastigiata, *Fr.*
— Eckloni, *Spr.*
— linearis, *Sw.*
— geniculata, *Bab.*
2. (B) R. scopulorum, *Ach.*

* Only those varieties which are well marked and somewhat constant are here introduced.

† (B) indicates species or varieties, which are *British*.

Tribe VII. Peltigerei.

Genus 1. Peltigera.

Species 1. (B) P. rufescens, *Hffm.*

Genus 2. Nephroma.

Species 1. N. antarcticum, *Jacq.*
var. tenue, *Nyl.*

Tribe VIII. Parmeliei.

Genus 1. Stictina.

Species 1. S. dissimilis, *Nyl.*
2. (B) S. crocata, *L.*
3. (B) S. fuliginosa, *Dicks.*

Genus 2. Sticta.

Species 1. S. latifrons, *Rich.*
2. S. filix, *Hffm.*
3. (B) S. damæcornis, *Ach.*
(N*) *var.* subcaperata, *Nyl.*
4. (N) S. subcoriacea, *Nyl.*
5. S. Urvillei, *Del.*, and
var. flavicans, *Hook.*
— Colensoi, *Bab.*
6. S. orygmæa, *Ach.*
7. S. rubella, *Hook.* and *Tayl.*
8. S. granulata, *Bab.*
9. S. dissimulata, *Nyl.*
var. multifida, *Laur.*
10. S. fossulata, *Duf.*, and
var. Richardi, *Mnt.*
11. S. physciospora, *Nyl.*
12. S. Freycinetii, *Del.*
13. (N) S. episticta, *Nyl.*

Genus 3. Ricasolia.

Species 1. R. coriacea, *Hook.* and *Tayl.*
2. (B) R. herbacea, *DN.*
(N) *var.* adscripta, *Nyl.*
3. R. Montagnei, *Bab.*

Genus 4. Parmelia.

Species 1. (B) P. perlata, *Ach.*, and
(B) *var.* ciliata, *Schær.*
2. (B) P. perforata, *Ach.*
3. (B) P. physodes, *Ach.*
var. enteromorpha, *Ach.*
4. (B) P. pertusa, *Schrank.*

* (N) indicates species and varieties new to science.

Genus 4. Parmelia—*continued.*

Species 5. (B) P. saxatilis, *Ach.*, and
(B) *var.* omphalodes, *Fr.*
— panniformis, *Schœr.*
6. (B) P. lævigata, *Ach.*, and
(B) *var.* sinuosa, *Sm.*
7. (B) P. olivacea, *Ach.*
8. (B) P. caperata, *Ach.*
9. (B) P. conspersa, *Ach.*
10 (B) Mougeotii, *Schœr.*

Genus 5. Physcia.

Species 1. (B) P. chrysophthalma, *L.*
2. (B) P. parietina, *L.*
3 (B) P. stellaris, *Fr.*, and
var. radiata, *Nyl.*
4. (B) P. cæsia, *Fr.*
5. (N) P. plinthiza, *Nyl.*

Tribe IX. GYROPHOREI.

Genus 1. Umbilicaria.

Species 1. (B) U. polyphylla, *Hffm.*

Tribe X. LECANOREI.

Genus 1. Pannaria.

Species 1. (N) P. immixta, *Nyl.*
2. P. leucosticta, *Tuck.*
3. (N) P. gymnocheila, *Nyl.*
4. (B) P. nigra, *Huds.*

Genus 2. Psoroma.

Species 1. P. sphinctrina, *Mnt.*, and
(N) *var.* pholidotoides, *Nyl.*

Genus 3. Placopsis.

Species 1. (B) P gelida, *L.*
2. (N) P. perrugosa, *Nyl.*

Genus 4. Squamaria.

Species 1. (B) S. galactina, *Ach.*
var. dispersa, *Pers.*

Genus 5. Placodium.

Species 1. (B) P. murorum, *DC.*

Genus 6. Lecanora.

Species 1. (B) L. vitellina, *Ach.*
2. (B) L. aurantiaca, *Lightf.*
(B) *var.* erythrella, *Ach.*
3. L. pyracea, *Ach.*

Genus 6. Lecanora—*continued.*

Species 4. (N) L. homologa, *Nyl.*
5. (N) L. peloleuca, *Nyl.*
6. (N) L. thiomela, *Nyl.*
7. L. umbrina, *Ehrh.*
8. (B) L. ferruginea, *Huds.*
9. (B) L. cinerea, *Ach.*
10. (B) L. atra, *Ach.*
11. L. punicea, *Ach.*
12. L. chrysosticta, *Tayl.*
13. (B) L. parella, *Ach.*
14. (B) L. glaucoma, *Ach.*
15. (B) L. simplex, *Dav.*

Genus 7. Urceolaria.

Species 1. (B) U. scruposa, *Ach.*
2. U. stictica, *Krb.*

Genus 8. Pertusaria.

Species 1. (B) P. communis, *DC.*
2. (B) P. velata, *Turn.*
3. (N) P. perrimosa, *Nyl.*
4. (N) P. perfida, *Nyl.*

Genus 9. Thelotrema.

Species 1. (B) T. lepadinum, *Ach.*
2. T. monosporum, *Nyl.*

Tribe XI. Lecidiei.

Genus 1. Cœnogonium.

Species 1. C. implexum, *Nyl.*

Genus 2. Lecidea.

Species 1. L. furfuracea, *Pers.*
2. L. subsimilis, *Nyl.*
3. (B) L. sabuletorum, *Flk.*
4. L. trachona, *Flot.*
(N) *var.* marginatula, *Nyl.*
5. (N) L. allotropa, *Nyl.*
6. (B) L. coarctata, *Ach.*
(N) *var.* exposita, *Nyl.*
7. (N) L. melanotropa, *Nyl.*
8. L. marginiflexa, *Tayl.*
9. L. millegrana, *Tayl.*
10. (B) L. pulverea, *Borr.*
var. Laurocerasi, *Del.*
11. (N) L. leucothalamia, *Nyl.*
12. (N) L. Otagensis, *Nyl.*
13. L. arceutina, *Ach.*
14. (N) L. amphitropa, *Nyl.*

Genus 2. Lecidea—*continued.*

Species 15. (B) L. parasema, *Ach.*, and
var. latypea, *Ach.*
(B) — enteroleuca, *Ach.*
16. (B) L. contigua, *Fr.*, and
(B) *var.* crustulata, *Ach.*
17. (B) L. lapicida, *Fr.*
var. declinans, *Nyl.*
18. (B) L. fusco-atra, *Ach.*
19. (B) L. petræa, *Flot.*
20. (B) L. stellulata, *Tayl.*
21. (B) L. myriocarpa, *DC.*
22. (B) L. lenticularis, *Ach.*
23. (B) L. grossa, *Pers.*
24. (N) L. flavido-atra, *Nyl.*
25. (B) L. geographica, *Ach.*

[Abrothallus.]
26. (B) L. oxyspora, *Tul.*
27. (N) L. Curreyi, *Linds.*

Tribe XII. GRAPHIDEI.

Genus 1. Opegrapha.

Species 1. (N) O. agelæoides, *Nyl.*
2. (N) O. spodopolia, *Nyl.*
3. (N) O. subeffigurans, *Nyl.*

Genus 2. Platygrapha.

Species 1. (N) P. longifera, *Nyl.*

Genus 3. Arthonia.

Species 1. A. excedens, *Nyl.*
2. (N) A. platygraphella, *Nyl.*
3. A. conspicua, *Nyl.*

Tribe XIII. PYRENOCARPEI.

Genus 1. Verrucaria.

Species 1. (B) V. pallida, *Ach.*
2. (B) V. nitida, *Schrad.*, and
var. nitidella, *Flk.*
3. V. glabrata, *Ach.*
4. (B) V. epidermidis, *Ach.*
(B) *var.* punctiformis, *Ach.*
5. (B) V. maura, *Wahl.*

The most interesting statistical features of the foregoing list may be conveniently exhibited in the following table :—

Genus.	Total Species* collected.	Number new to Science.	Geographical Distribution.		
			Confined to New Zealand.	British.	Not British, but common to New Zealand and other countries.
Collema,	1	...	...	1	...
Sphærophoron,	1	...	...	...	1
Cladonia,	5	...	...	4	1
Stereocaulon,	3	...	1	...	2
Usnea,	1	...	...	1	...
Ramalina,	2	...	...	2	...
Peltigera,	1	...	...	1	...
Nephroma,	1	...	...	...	1
Stictina,	3	...	...	2	1
Sticta,	13	2	3	1	9
Ricasolia,	3	...	1	1	1
Parmelia,	10	...	...	10	...
Physcia,	5	1	1	4	...
Umbilicaria,	1	...	...	1	...
Pannaria,	4	2	2	1	1
Psoroma,	1	...	...	...	1
Placopsis,	2	1	1	1	...
Squamaria,	1	...	...	1	...
Placodium,	1	...	...	1	...
Lecanora,	15	3	3	8	4
Urceolaria,	2	...	...	1	1
Pertusaria,	4	2	2	2	...
Thelotrema,	2	...	...	1	1
Cœnogonium,	1	...	...	...	1
Lecidea,	27	7	9	14	4
Opegrapha,	3	3	3	...	...
Platygrapha,	1	1	1	...	...
Arthonia,	3	1	2	...	1
Verrucaria,	5	...	...	4	1
Total,	122	22	30	62	30

* *Excluding* varieties, where they occur in addition to the type Their aggregate number is 26, which, added to the species, gives a total of 148.

Analysing this table, the first point that claims attention is, that of a total of 122 species, 22 are *new to science.* To these must be added 7 varieties, also new to science, making a total of 29, or 19 per cent. of the whole number collected. These additions to the Lichen-flora of the world are in the genera *Lecidea*, *Lecanora*, *Opegrapha*, *Pertusaria*, *Pannaria*, *Sticta*, *Arthonia*, *Platygrapha*, and *Physcia*. All the *Opegraphæ* are new; as is the only *Platygrapha;* and as are also one-half of the *Pannariæ* and *Pertusariæ*, one-third of the *Arthoniæ*, one-fourth of the *Lecanoræ*, one-fifth of the *Lecideæ* and *Physciæ*, and one-sixth of the *Strictæ*.

In addition to the species new to science, 46 species and 20 varieties had not, apparently, previously been found in, or recorded as natives of, New Zealand—making thus a total of 68 species and 27 varieties, or 64 per cent. of the whole, *new to the flora of New Zealand.* Of *genera*, two are additions to the New Zealand flora—*Umbilicaria* and *Placodium*.

As regards their *geographical distribution*, 62 species, or 50 per cent., are common to Britain; 30, or 24 per cent., are confined to New Zealand; 62 per cent. are common to both northern and southern hemispheres; and 38 per cent. confined to the latter. The great majority are, therefore, *widely diffused* over the world; and they include not a few cosmopolites, especially in the genera *Cladonia*, *Usnea*, *Ramalina*, *Parmelia*, *Physcia*, *Lecanora*, *Pertusaria*, *Lecidea*, and *Verrucaria*. 30 species, though not British, are common to New Zealand, with other islands or countries, mostly in the Southern hemisphere. The latter include Australia and Tasmania, and their outlying islands (New Caledonia); the various antarctic lands and islands (Cape Horn, Straits of Magellan, Auckland islands); South America and its outlying islands (Juan Fernandez); Southern Africa; and the Polynesian islands (Fiji). The species, which are common to both hemispheres, occur, in the Northern, in various parts of Europe (Scandinavia and Central Europe especially), Northern Africa, Asia, North America (Mexico and West Indies), and the Sandwich islands. A few species are also tropical or equatorial, inhabiting equatorial America (Guiana and New Granada), Africa, or Java.

The genera richest in species are, in the order of their richness—

1. Lecidea.	5. Verrucaria.
2. Lecanora.	6. { Cladonia.
3. Sticta.	6. { Physcia.
4. Parmelia.	

Crustaceous bear to *foliaceous* species the numerical relation of about 100 to 70. In the former class, most of the new species occur—in the proportion of about 100 to 30.

As indicative of the progress of New Zealand Lichenography, it may be stated, in conclusion, that the foregoing imperfect enumeration does not fall far short (in the number of the species) of the total Lichen-flora of New Zealand as given in Dr Hooker's standard work, "Flora Novæ Zelandiæ," in 1853, the precise numerical relation standing thus:—

I. In Babington's List of whole New Zealand Lichen-flora, ...	171 species.
	27 vars.
Total,	198*
II. In present List of a small number of Otago Lichens, ...	122 species.
	26 vars.
Total,	148†

there having been, in the interval between the publication of the lists in question—1853 and 1865—only two papers issued on New Zealand Lichenography (in 1860), by Knight and Mitten.

A letter was read from Dr J. C. Brown, colonial botanist, Cape of Good Hope, intimating that he had sent for the Botanic Gardens at Edinburgh and Glasgow specimens of *Welwitschia mirabilis*. The plants had been contributed

* This number will fall to be largely reduced if we subtract—1. Doubtful natives of New Zealand. 2. Doubtful species and varieties.

† This number would be somewhat increased were I to add to it several species and varieties collected in a state unfit for accurate determination: that is to say, whose apothecia were degenerate, and contained no properly developed thecæ and spores.

by Mr Chapman. Professor Balfour stated that the plants, unfortunately, had reached Edinburgh in a very unsatisfactory condition, and the specimen in the Garden had shown no signs of vitality.

As some doubts have been expressed relative to the occurrence of *Sison Amomum* in Scotland, Professor Balfour exhibited specimens collected by himself, in August 1831, in the neighbourhood of Coldstream, not far from The Hirsel, the residence of the Earl of Home. He also stated that *Œnanthe fistulosa*, which is not recorded as a Scotch plant by Professor Babington, occurs abundantly in Wigtonshire, Kirkcudbrightshire, and Dumfriesshire, in all of which localities he had collected it.

Dr Balfour exhibited specimens of an Aster, apparently *Aster salignus* (*salicifolius*), which he found growing in quantity on an island in the Tay, near Dalguise, far from any gardens, and apparently naturalised. He remarked that several species of Aster were spread over Britain, and he exhibited specimens of two species which had been collected near Coldstream and on the banks of the Thames.

Dr Balfour read a letter from Dr Murchison, of London, in reference to the Falconer Memorial and the Falconer Natural History Fellowship, in which he stated that the sum now amounted to upwards of L.1800. In order to endow a proper fellowship in the University of Edinburgh, the sum of L.2500 or L.3000 will be required. He requested Scotch naturalists to aid in the cause.

A correspondent of the Society mentioned, that at Bonchurch, near Ventnor, Isle of Wight, he noticed a Fuchsia nearly 22 feet high, and having a trunk 7 inches in diameter.

Mr M'Nab laid before the Society specimens of *Raphanus caudatus*, grown in the open air, and stated that he had exhibited a growing specimen at the last meeting in July, but as time did not then allow of any remarks being made, he now communicated the following notes:—The seeds of

the plant were received from Mr William Bell, superintendent of the Botanic Garden, Saharunpore, in April 1865, under the name of "Radish, 3 feet long." The seeds were dibbled into a piece of ground prepared for the purpose, and a two-light frame placed over them. They very soon commenced to grow, so that the glazed frame had to be removed. Seven weeks after being sown, they flowered profusely, and numerous seed-vessels of a purplish green colour were produced. These went on elongating till many of them had reached the length of 2 feet 9 inches, each plant bearing from eighteen to twenty long tapering snake-shaped seed-vessels. In the young state the siliquas or seed-pods may be used like the ordinary cultivated ground radish, as they possess a peculiar pungent taste. They will also be found very useful for making up mixed pickles, &c. About eight years ago seeds were received from Madras under the name of "Rat-tail Radish, *Raphanus caudatus*," with seed-pods 8 inches long. This variety produces seeds freely, and is annually grown in the garden. It possesses the same pungent taste as the long-fruited plant. The large radish is very hardy, as both flowers and fruit were found on it in the open air as late as 9th November 1865. Independent of the various culinary purposes to which this radish may be turned, it is of itself a remarkable vegetable curiosity. If the seeds are sown singly, and each plant tied upright, the fruit will, when matured, be found hanging all round—sometimes perfectly straight, at other times assuming contorted forms. This peculiar contortion is most perceptible at the period when the seeds in the upper portion of the siliqua are swelling. At no stage of their growth does either of the varieties show the slightest tendency to produce the radish under ground. It will be curious to observe the nature of the offspring when the plant is fertilised with the ordinary garden radish—in all likelihood the hybrids will produce edible radishes, both above and under ground.

Mr Bryson exhibited two species of gourds which had grown in his garden at Hawkhill, along with vegetable marrow. One of them seemed to be *Cucurbita aurantium*, and the other was a pale yellow pyriform fruit, very bitter,

which had been served at table by mistake for vegetable marrow.

Dr Balfour exhibited drawings of fruits, seeds, and implements, taken from the ancient Lake Dwellings in Switzerland.

An old herbarium was exhibited, which had been presented to the College of Edinburgh, on 29th January 1702, by Mr Robert Eliot, surgeon-apothecary, and Fellow of the Royal College of Surgeons.

14*th December* 1865.—Professor Balfour, in the Chair.

The following Gentlemen were elected Office-bearers for 1865–66 :—

President.

Robert K. Greville, LL.D.

Vice-Presidents.

Professor Allman.
Humphrey Graham, W.S.
Professor Maclagan.
I. Anderson-Henry, S.S.C.

Council.

William Seller, M.D.
James M'Nab.
Charles Jenner.
Andrew Inglis, M.D.
F. B. W. White, M.D.
William Gorrie.
Professor Archer
Wm. Rutherford, M.D.
Alex Buchan, M.A.
G. M. Lowe.

Honorary Secretary.........Professor Balfour.
Honorary Curator..........The Professor of Botany.
Foreign Secretary............Alexander Dickson, M.D.
Auditor.........................William Brand, W.S.
Treasurer.......................Patrick Neill Fraser.
Artist..........................Neil Stewart.
Vice-Secretary and Curator............John Sadler.

The following Gentlemen were duly elected Members of the Society:—

Resident Fellows.
John Kirk Duncanson.
Gilbert C. A. Stewart.
John Baddeley.
David W. Roberts.

Non-Resident Fellow.
John Fraser, M.D., Wolverhampton.

Foreign Member.
Dr William Nylander, Paris.

The following Donation to the Library was laid on the table:—

Jahrbücher für Volks und Landwirthschaft for 1861–64, Dresden.—From the Royal Economical Society of Saxony.

Mudd's specimens of British Cladoniæ were announced as having been added to the University Herbarium.

Dr Greville, President, in the Chair.

The following Communications were read:—

I. *Observations on the Genus Moringa.* By N. A. Dalzell, M.A., Bombay. Communicated by Professor Balfour.

It is surprising that no botanist who has discussed the affinities of the curious genus Moringa has noticed the very remarkable resemblance of its ripe capsule to the fruit of the Bignoniaceæ. In both there is a long, slender, pendulous capsule, with winged seeds, seated in cavities of a corky or spongy placenta. The seeds of both are exalbuminous and parietal, with the radicle next the hilum. Although the seeds of Bignoniaceæ are generally transverse, yet Moringa agrees with the tribe Incarvilleæ in having the seed pendulous, while in the amygdaloidal character of the cotyledons, Moringa resembles Oxycladus (Miers) and Crescentia.

In habit, foliage, and inflorescence there is a very striking resemblance between Moringa and Bignoniaceæ, so much so, that one species of Bignonia has been named by Decan-

dolle, *moringæfolia.* If the leaves of *Moringa, Millingtonia hortensis* and *Bignonia xylocarpa* are placed together, this resemblance is particularly striking, and a peculiarity is observable common to all three, viz., that the lowest pair of pinnæ, or ultimate pinnulæ, as the case may be, are nearly always trifoliolate, the odd one being larger than the pair of leaflets. The leaves of the plumule, as developed in germination, are triternate in Moringa.

Although the leaves in Bignoniaceæ are generally opposite, yet Moringa agrees with Spathodea, and some others in having them alternate. The testa of the seed in Bignoniaceæ is generally reticulated, and in this peculiar feature Moringa agrees with that family. The reticulation does not extend to the wings.

Description of the Flower of Moringa.

Calyx.—With imbricated æstivation, the entire portion cup-shaped oblique, the anterior being only half the depth of the posterior side. The odd sepal is posterior, and the five divisions reflexed, and coloured as in Eccremocarpus, Fridericia, Solenophora, &c.

Corolla.—Moringa is said to be polypetalous; but I must regard it as gamopetalous, the entire portion being soldered to the tube of the calyx, and thus making an approach to Platycarpum, in which there is scarcely any tubular portion above the calyx. Wight and Arnott make mention of a fleshy torus, and Bentham and Hooker describe this as a fleshy disk with a free margin, and lining the tube of the calyx. There appears to me to be no such disk with a free margin, and my subsequent remarks will show that there could not be such a disk. In fact, the so-called disk is nothing but the consolidated bases of ten filaments, the vessels of which can be traced under the microscope upwards continuously through the filaments.

Stamens.—These are described as ten in number, five being imperfect and alternate with five which are fertile. No one appears to have noticed that four of these fertile stamens are didynamous, the anthers being brought together in pairs, and their filaments having that peculiar arcuate form necessary to effect this arrangement, while the

fifth and posterior odd stamen, generally rudimentary in Bignoniaceæ, is here fertile and longer than the others, as in Kigelia and Calosanthes.

Had Linnæus observed this, he would probably have placed Moringa in his class Didynamia. In Bignoniaceæ, the four or five fertile stamens are in their normal position, viz., opposite the segments of the calyx, and five glands (disk), sometimes assuming the shape of filaments, surround the ovary, and alternate with the stamens.

In Moringa, on the other hand, there appears to me to be a transposition of development, so to speak; for while in Bignoniaceæ it is the *outer* series that are perfect, the inner series being glands, in Moringa it is the *inner* series that become perfect stamens, while the outer series, opposite the calyx segments, remain as glandular bodies, being destitute of the essentials of stamina.

These remarks on the stamens seem to derive peculiar confirmation from a remark of Griffith's (Posthumous Papers, vol. ii. page 228), where he says, "Bignonia with fifteen stamens may be expected, and what is singular, if such is found, the additional stamina, opposite the existing five (3rd series) will be more developed, in compensation, perhaps, for the great development of the corolla." In Moringa it is the second series that are more developed.

As regards the one-celled anthers in Moringa, we find them so in Jacaranda, Colea, and still more generally in the allied Cyrtandraceæ; in fact, the anthers of Isanthera and Didymocarpus are identical with those of Moringa.

The tricarpellary, instead of dicarpellary, fruit in Moringa, presents no greater difficulty than in the case of the dicarpellary fruit of Affonsea in the Leguminosæ, nor can it be thought strange, that flowers formed upon a quinary type should have any number of carpels below six; and although among Corollifloral orders, a tricarpellary ovary is not common, yet it does occur in Solanaceæ, Polemoniaceæ, &c., and I have observed the same frequently in the genus Gesneria. Aceraceæ have a two-celled fruit, and they are closely related to Sapindaceæ with a three-celled fruit. For the reasons above stated, I conclude that Moringa really belongs to the Bignonial alliance, holding an intermediate place between Bignoniaceæ proper, and Crescentiaceæ.

If the structure of the seed, the seed-vessel, and the foliage, are of greater value in determining affinities than other parts of structure, then we find that in these points, united to habit, there is a wonderful agreement of Moringa to the families named, and that the apparent discrepancies are capable of explanation under this view, and are confined to points of least importance. Among these last, the perfect union of the corolla with the calyx tube in Moringa may be quoted as an example. We find free and adnate corollas in one and the same family; as, for example, Erblichia and Turnera in the order Turneraceæ.

Considering how little is known of the *Anoma cochinchinensis*, with its bivalved fruit, it is possible that Loureiro may have been right in placing it along with his *A. Morunga*; it may, for all we know, be the typical species of the genus Moringa.

As *Parmentiera edulis* in the new world yields a fruit which is cooked and eaten as a vegetable, so in the old world the fruit of *Bignonia xylocarpa* and Moringa is used in the same way.

The former, as well as *Heterophragma chelonioides* and *Crescentia Cujete* have oily seeds, and possibly this may be a characteristic of the whole Order.

Since writing the above, another unexpected agreement between Moringa and Bignoniaceæ has been observed. On examining the under surface of the leaflets of Moringa, they will be found minutely lepidote, agreeing in this particular with all the Bignoniaceæ which I have had an opportunity of examining. The scales are more or less distinct in all, but conspicuously so in *Spathodea falcata*, *Heterophragma Roxburghii*, *Bignonia xylocarpa*, and *Crescentia Cujete.*

II. *On Asplenium Petrarchæ*, DC., *as an Irish Plant.* By F. Naylor, Esq.

Mr Naylor exhibited a specimen of the frond of *Asplenium Petrarchæ*, which he had received through the kindness of Lord Clermont, whose Lady had collected it near Flurry Bridge in Ireland. Only one plant was observed,

and since its discovery the station has been robbed by some fern collector. It is to be hoped that it will be found in some other Irish station. Specimens of the plant from the University Herbarium were also exhibited, collected at Vaucluse, Montpellier, Sierra de Gador and Sierra Vernisa in Spain. From the single frond of the Irish specimen which was shown, it was not easy to come to a definite conclusion as to the species. Mr Newman, however, has determined the Irish plant to be the true *Asplenium Petrarchæ*, and has noticed it in the popular fourth edition of his "British Ferns."

III. *Notice of the effects of the Cyclone of 5th October 1864 on the Botanic Garden, Calcutta.* By Dr Thomas Anderson.

The history and general character of the Cyclone as it occurred at Calcutta have been repeatedly narrated, and are so well known to every one, that no description is required here. As experienced in the Botanical Garden, the cyclone differed in being somewhat more violent than in Calcutta, and the influence of the storm-wave extended more inland. The greater fury of the storm in the Botanical Garden is accounted for by the garden being nearer the centre of the cyclone than Calcutta, but principally by the open surface of the river, across which the gale at its height blew diagonally, and thus struck the garden with a force unbroken, for the space of a mile, by any obstacle whatever. Few trees fell before 11 o'clock A.M. on the 5th October, and almost none after 4.30 P.M. At 4 o'clock, the great specimen of *Adansonia digitata*, the Baobab tree of Africa, was uprooted, and fell with a crash that caused vibrations in the earth which were felt at a distance of some hundred yards. This tree, which had withstood the greatest force of the gale, seems to have at last given way from its roots having become loosened in the soil by the storm-wave, whose waters rose to a height of 4 feet on the trunk of the tree. Three gigantic specimens of *Casuarina equisetifolia*, the oldest of the species in the garden, and none of them less than 150 feet in height, fell comparatively early in the storm. One of them was seen in the act of falling about

11 A.M. Many trees, but especially *Casuarina equisetifolia*, and young specimens of Teak, were not uprooted, but their stems were broken across 15 or 20 feet above the ground, while every branch was wrenched off. They are now nothing but bare poles without a leaf. The devastating wave overthrew almost every shrub and small tree that had withstood the fury of the wind, loosened and swept away the soil about the roots of large trees, and thus caused many of them to fall even after the great force of the storm was exhausted. The garden was covered with straw brought up by the tide and storm-wave from the villages below. Many hundred cartloads of straw were collected and burned some weeks after the cyclone. Timber and rubbish of all kinds were scattered everywhere, and even a portion of the helm of a ship was carried a quarter of a mile into the garden, and was found at the base of a large tree of *Gmelina arborea*, opposite the dwelling-house of the gardener of the Agri-Horticultural Society. Near this a log of mahogany, 4 feet in diameter and 15 feet long, was overturned by the storm-wave; and near the centre of the garden another log, 2 feet thick and 20 feet long, was carried some distance by the receding wave. Many of the most picturesque parts of the garden resulting from the grouping of trees, or from well-developed single specimens, no longer exist. In the teak avenue, along the road from Kyd's monument to the large bridge over the Khal, only two mutilated specimens remain. The trees in this avenue were sixty-nine years old. Out of sixty-seven mahogany trees thirty-one have been blown down, two of which were sent to this garden by the Court of Directors of the East India Company in 1796. These two trees had attained a circumference of 13 feet 6 inches, and had produced seed for the last two years. The mahogany grove, consisting of trees forty-five years old, is destroyed. The Casuarina avenue, planted by Dr Wallich, has suffered severely. Only four trees in it are standing, and these are much injured. Three of the originally introduced specimens of this species, and which were the parents of nearly all the Casuarinas near Calcutta, were blown down. The magnificent specimen of *Adansonia digitata*, whose diameter is 12 feet, fell towards the end of the storm after the storm-wave had

passed over the garden. All the trees of *Amherstia nobilis* have been partially uprooted; they are supported merely by their branches, and all of them must be removed after young plants have been obtained from them by layering. The great Banyan received considerable damage, but fortunately on the north side, where the loss of the branches does not in the least spoil the contour of the tree. The Pinetum, containing many fine specimens of Araucaria, suffered much from the storm. Of about twenty-five specimens of Araucaria not one has been left with the main stem entire; in most of the trees nearly a third of the stem and branches remain. Among Coniferæ, the destruction of all the trees of *Pinus longifolia* deserves notice; also of a very large specimen of *Dammara orientalis*, introduced from Amboyna in 1798. Amidst all this destruction, I am glad to be able to report that Cycadeæ and palms, and indeed Endogenæ generally, have escaped with little injury. Only two species of palms have suffered severely—one is *Areca Catechu*, the common betel-nut palm, of which hardly a specimen now remains in the garden, and *Arenga saccharifera*, most of the trees of which have been blown out of the perpendicular, although few of them have been uprooted. The great destruction of exogens by the cyclone, while endogenous species escaped, produced a peculiar effect on the scenery about Calcutta. The country, as seen from the roof of my dwelling-house, a height of 80 feet, appears to be covered with three species of palms, *Cocos nucifera*, *Phœnix sylvestris*, *Borassus flabelliformis*, and bamboos. The destruction of the foliage of the trees and shrubs at an unnatural period, and indeed at the time when the trees had ceased to grow, and were maturing the woody growth of the rainy season, has had a strange influence on some species. The most general effect has been the absence of flowers in spring, and departures from the usual course of shedding of leaves.

Some trees have been killed by the mere force of the wind, or by the violent strain they have sustained. The pressure during the height of the storm is said to have been 120 lbs. on the square foot. Some species, especially of Dipterocarpeæ, Guttiferæ, the genera Dalbergia, Pterocarpus, Acacia, Araucaria and Dammara have their stems

covered with exudations of resin, or gum, which have oozed through the bark on the upward flow of the sap in March. There are very few species of trees in the garden of which specimens have not been thrown down; the only species that seem to have entirely escaped, and of which the specimens, with few exceptions, are unique, are—

Dipterocarpus alatus	Terminalia angustifolia
Cratæva Roxburghii	citrina
Flacourtia cataphracta	Berryi
Hydnocarpus inebrians	travancorensis
Gynocardia odorata	tomentosa
Eriodendron orientale	paniculata
Sterculia ornata	Nauclea parviflora
comosa	cordifolia
angustifolia	Mimusops hexandra
Visenia velutina	indica
Hopea faginea	Diospyros Sapota
Acer oblongum	embryopteris
Ailanthus excelsa	Spathodea Rheedii
Erythrina indica	adenophylla
Pterocarpus indicus	Vitex saligna
dalbergioides	Camphora officinarum
Poinciana regia	Beilschmiedia Roxburghiana
Cassia nodosa	Cryptocarya floribunda
Pithecolobium bigeminum	

The greater number of species of Ficus have also escaped. The powerful aërial roots of many of this species enable these trees to resist the most violent storms. It is apparent, from this imperfect inquiry, that at least one-half of the trees have been blown down, while nearly all that are standing are very much shattered.

In the following extensive list of trees uprooted by the Cyclone no account is taken of innumerable small trees and shrubs, nor of injuries to trees that may have been left standing; all such have been excluded from the list, which thus contains only species that have been thrown down and destroyed. The list contains 1010 specimens distributed among 364 species, which is nearly the entire number of arborescent species in the garden.

Trees uprooted in the Royal Botanical Garden, Calcutta, in the Cyclone of 5th October 1864.

Dilleniaceæ.

1 Dillenia retusa. Grafted on Dillenia scabrella.
1 Dillenia scabrella
1 pentagyna
1 speciosa

Magnoliaceæ.

1 Magnolia sphenocarpa. Planted by Dr Roxburgh.
1 Michelia champaca

Anonaceæ.

1 Alphonsea ventricosa. Unique. Introduced in 1797.
1 Saccopetalum longiflorum
1 Guatteria fasciculata

Canellaceæ.

1 Canella alba

Bixineæ.

4 Cochlospermum orinocense
2 Bixa orellana
1 Flacourtia ferox
    inermis. The only original specimen of Dr Roxburgh's planting left.
1   rotundifolia. Unique.

Tamariscineæ.

1 Tamarix indica

Hypericineæ.

3 Ancistrolobus carneus

Guttiferæ.

5 Calophyllum Inophyllum
1 Mammea siamensis
3 Xanthochymus pictorius
1   dulcis
3 Garcinia Roxburghii. No uninjured specimen left.
1   purpurea
3   Cowa
1   cornea. One uninjured specimen left.

Dipterocarpeæ.

1 Dipterocarpus lævis. Unique. Introduced before 1794.
2 Shorea robusta. One specimen remaining.
1 Hopea odorata

Malvaceæ.

1 Kydia calycina
1 Hibiscus tortuosus
3   macrophyllus
1   tricuspis
1 Thespesia populnea
2 Adansonia digitata. Two small specimens left.
2 Bombax malabaricum
1 Ochroma Lagopus. Unique. Species lost.

Sterculiaceæ.

3 Sterculia villosa
1   colorata
1   alata
1   urens
2   fœtida. All large specimens lost.
1   parviflora
1   guttata
2   pallens
4   companulata
4   populifolia
1 Heritiera macrophylla
1   littoralis
4 Kleinhovia hospita
3 Pterospermum lancifolium
2   aceroides
1   acerifolium
1   suberifolium
6 Eriolæna spectabilis
1   Candollei
1 Guazuma tomentosa

Tiliaceæ.

2 Grewia asiatica
1 Elæocarpus longifolius
3 Berrya Ammonilla

Lineæ.

1 Erythroxylon monogynum

Rutaceæ.

1 Xanthoxylon Budrunga
1 Clausena sumatrana
2 Feronia Elephantum
1 Ægle Marmelos

Simarubaceæ.

1 Balanites ægyptiaca. Unique. A few seedlings raised last year remaining.

Burseraceæ.

5 Boswellia thurifera
7 Garuga pinnata
1 Balsamodendron Roxburghii
1 Icica indica
1   bengalensis
1 Canarium geniculatum
1 Filicium decipiens

Meliaceæ.

2 Melia composita

1 Melia sp.
1 Azadirachta indica
4 Epicharis exarillata
1 Sandoricum indicum
1 Mallea Rothii
3 Aglaia undulata
3 spectabilis
1 midnaporensis
1 Milnea edulis
4 Amoora Rohituka
1 Walsura robusta
Piscidia.
1 Heynea trijuga
32 Swietenia Mahagoni (old)
12 (young). These plants were 12 years old.
8 Swietenia Chloroxylon
3 Soymida febrifuga
8 Chickrassia tabularis
2 Cedrela Toona. All the large trees lost.

Olacineæ.

1 Olax scandens

Celastrineæ.

1 Euonymus grossus
1 glaber
1 Celastrus fascicularis
1 Elæodendron longifolium
1 glaucum

Sapindaceæ.

1 Cupania canescens
1 sapida
1 madagascariensis
1 Scytalia mangifolia
1 Schleichera trijuga
3 Erioglossum edule
1 Sapindus angustifolius
3 emarginatus
2 Saponaria
1 Nephelium Litchi
1 Longan
2 Harpulia cupanioides

Sabiaceæ.

2 Meliosma simplicifolia

Anacardiaceæ.

1 Rhus parviflora
43 Mangifera indica
1 (Singapore)
2 Bonea oppositifolia. A few small plants left.
1 Buchanania latifolia
1 angustifolia
8 Melanorrhœa usitatissima. One plant left.
2 Schinus terebinthifolia
1 Semicarpus Anacardium
1 cuneifolia
3 Holigarna racemosa
1 Spondias *sp.*
1 lutea

Moringaceæ.

2 Moringa pterygosperma

Leguminosæ.

1 Agati grandiflora
2 Erythrina ovalifolia
1 stricta
3 Butea frondosa
5 Pterocarpus Marsupium
3 Pongamia glabra
1 heterocarpa
4 tetraptera
35 Dalbergia Sissoo
4 zeylanica
1 frondosa
1 latifolia. One much injured specimen remains.
1 scandens
1 sp. (Madras)
1 Colvillea racemosa
2 Poinciana regia
1 Lebidibia coriaria
11 Jonesia Asoca
5 Tamarindus indica
4 Hymenæa Courbaril
5 Phanera Richardiana
9 purpurea
1 parviflora
2 retusa
4 Hardwickia binata
1 pinnata. Unique.
2 Parkia biglandulosa
1 Brunonis
1 Prosopis spicigera
1 Cassia emarginata
1 Fistula
1 grandis
1 sumatrana
2 Xylia dolabriformis

5 Pithecolobium dulce
4 Acacia Serissa
1 tomentosa
6 Catechu
1 Sundra
1 Albizzia stipulata
1 elata
1 paludosa
1 Smithiana
3 odoratissima
2 diluta

Rosaceæ.

1 Photinia bengalensis
1 eugenifolia

Combretaceæ.

3 Terminalia Chebula
1 tomentosa
2 Catappa
1 Belerica
3 Arjuna
1 procera
2 sp. Unique, entirely lost.
1 oblonga
1 bialata

Terminaliæ have hardly suffered at all. Many specimens of all, except the above-mentioned species, remain.

2 Conocarpus latifolius. Only a few small seedlings remain.

Rhizophoraceæ.

9 Carallia lucida

Lythraceæ.

1 Lagerstrœmia Regina
1 Byrsonima lucida
2 Lafœnsia vandelliana. Two small specimens, 2 years old, remain.
1 Duabanga sonneratioides

Alangiaceæ.

1 Alangium decapetalum

Myrtaceæ.

2 Eucalyptus resinifera
3 Callistemon salignum
1 lanceolatum
2 Metrosideros vera
2 Eugenia geminiflora
6 Jambolana
10 myrtifolia
2 malaccacensis
1 Eugenia pulchella
1 Psidium pomiferum
1 Melaleuca Cajuputi

Samydaceæ.

2 Homalium tomentosum.
1 longifolium

Araliaceæ

1 Tupidanthus calyptratus

Rubiaceæ.

2 Rondeletia tinctoria.
2 Hymenodictyon thyrsiflorum
5 Nauclea Cadamba
1 macrophylla
1 Randia rubiginosa
4 uliginosa
3 decussata
1 Gardenia longispina
5 latifolia
1 turgida
1 sp.
7 Ixora parviflora
3 Canthium floribundum
1 Morinda exserta
1 bracteata

Sapotaceæ.

1 Sapota Achras. Several specimens remain.
4 Sideroxylon attenuatum
1 inerme
1 Bassia longifolia
1 latifolia
1 butyracea
1 Imbricaria coriacea
1 Mimusops Elengi
1 Kaki

Ebenaceæ.

1 Diospyros Ebenum
4 montana
1 heterophylla
3 lancifolia
1 sp.
1 sp.
1 sp.

Jasminaceæ.

4 Olea europæa. One much injured old tree remains.
5 Visiania paniculata
2 robusta
1 Olea myrtifolia
1 grata

4 Olea glandulifera. Probably lost, except as regards seedlings in pots.
3 Linociera dichotoma
8 macrophylla
11 Noronhia emarginata
1 Nyctanthes Arbor-tristis

Apocynaceæ.

1 Plumeria acuminata
1 alba
1 Wrightia mollissima
5 Alstonia macrophylla. One tree left standing.
2 scholaris No large trees exist.
4 Holarrhena antidysenterica
1 Thevetia neriifolia

Loganiaceæ.

1 Strychnos Potatorum
1 spinosa

Bignoniaceæ.

1 Stereospermum fimbriatum
1 sp.
1 sp. (Pegu)
4 chelonioides
1 suaveolens
3 Spathodea amœna
2 xylocarpa
5 crispa
1 serrulata
1 stipulata
2 campanulata
3 Calosanthes indica
1 Millingtonia hortensis
4 Kigelia pinnata
4 Crescentia alata
3 Tecoma undulata. Two small plants a year old remain.
1 serratifolia

Boragineæ.

1 Cordia Myxa
5 Sebestena
1 lævis
1 tectonifolia
1 bantamensis
1 angustifolia
3 grandis
1 Ehretia lævis

Verbenaceæ.

3 Citharexylon subserratum
52 Tectona grandis (old). The majority of these are nearly 70 years old.
30 grandis (young). From 15 to 25 years old.
3 ternifolia. One specimen left.
2 Premna spinosa
2 Callicarpa arborea
4 Gmelina arborea
1 asiatica. One injured specimen left.
1 Vitex alata
1 Leucoxylon

Nyctaginaceæ.

1 Pisonia inermis

Polygonaceæ.

2 Triplaris americana

Proteaceæ.

4 Grevillea robusta. All the old seed-bearing trees have been destroyed.

Aquilariaceæ.

3 Aquilaria Agallochum

Santalaceæ.

5 Santalum album

Lauraceæ.

2 Cinnamomum malabathrum
1 Tetranthera Roxburghii
3 Tetradenia foliosa

Celtideæ.

1 Ulmus integrifolia
2 Celtis tetrandra
1 sinensis

Moraceæ.

1 Artocarpus Chaplasha
4 integrifolia. The species is lost except a small seedling in a pot.
3 Lakoocha
3 incisa
3 Ficus artocarpifolia. No large trees left.
1 indica
1 conglomerata

1 Ficus Roxburghii
1 excelsa
2 religiosa
1 Brosimum Alicastrum
2 Streblus asper

Euphorbiaceæ.

1 Aleurites triloba
2 Croton Joufra
1 oblongifolium
2 Cleidion javanicum
2 Trewia nudiflora
1 Rottlera tinctoria
1 tetracocca
1 Stillingia sebifera
1 Omalanthus sp.
1 Pierardia dulcis
2 Hemicyclia sepiaria
1 Briedelia amœna
1 lancifolia
3 Amanoa attenuata
1 Berryana
7 Phyllanthus tremulus
1 Emblica officinalis
1 Bischofia javanica
1 Glochidium lancifolium
1 Putranjiva Roxburghii
1 Cluytia collina
1 oblongifolia
1 Antidesma Bunius

Casuarinaceæ.

19 Casuarina equisetifolia. All the oldest trees have been lost.
8 Casuarina equisetifolia (young)

Coniferæ.

2 Juniperus virginiana
2 Cupressus torulosa
3 sempervirens
5 Pinus longifolia. All the trees have been lost. There are a few plants under five feet left.
1 Pinus khasyana. Unique species lost.
1 Araucaria Bidwillii
1 Cookii
1 Cunninghami
4 excelsa. The largest trees remain.
2 Dammara orientalis. One specimen introduced in 1797. No trees of this species exist here now.
1 Podocarpus Maki
1 neriifolia

Cycadaceæ.

1 Cycas circinalis. *C. sphærica* Roxb.
5 Rumphii. Many specimens remain.

Musaceæ.

1 Ravenala madagascariensis

Palmaceæ.

2 Oreodoxa oleracea. The original trees introduced by Lord Auckland remain.
39 Areca Catechu
4 Arenga saccharifera
3 Caryota urens
4 obtusa
4 sp.
1 Borassus flabelliformis
1 Corypha umbraculifera
1 Livistona sinensis
1 Chamærops Martiana
1 Phœnix sylvestris
8 Cocos nucifera

Pandanaceæ.

1 Pandanus odoratissimus

Gramineæ.

4 Bambusa gigantea. One specimen left.
1 arundinacea

Dr Wallich drew up a very full report on the effects of the gale of 3d June 1842. It appears from his report that that storm did great damage to the garden. Dr Wallich states that 362 trees were blown down. I observe that in this number he includes shrubs sometimes not more than five feet high; and he points out that of the 362 trees blown down 106 were teak trees, many of which were of large size.

This gale of 1842 happened before Mr Griffith had denuded the garden of most of its fine timber trees. The garden was then thickly covered with trees; and accordingly the number lost in that gale bore a very small proportion to the vast number left standing. In May 1843, eleven months after the gale, Mr Griffith, in his report to Government, says—"At present the garden is literally choked with trees." Had more trees existed in the garden when the Cyclone of last October occurred, it is most likely that less damage would have been sustained, as the trees would have sheltered each other. In a garden liable to be devastated at any time by furious storms, every arborescent species should be represented by at least five specimens. Unique specimens of many species must always exist, but still the endeavours of the Director should be to procure, if possible, five specimens of each species.

IV. *Notice of Plants collected in Iceland.* By M. Ed. Jardin, Cherbourg.

I have much pleasure in offering to the Botanical Society of Edinburgh some specimens of plants which I collected during my visit to Iceland, Faröes, and Norway. Perhaps there are some new species, but I have neither time nor books, nor experience sufficient to make a complete study of them. I shall, however, notice some plants which deserve attention, on account of their station and locality.

A species of Equisetum was gathered by me in hot-springs near Reykjavik; and in the place where it grows, the water was disagreeably warm to the hand. A species of Chara, and a Potamogeton were also gathered in those hot waters. In the waters of the hot-springs of the Geysers, in the interior of Iceland, a Juncus grows very near to the boiling cauldron. This is nearly always covered by the water, when it spreads outward from the opening; there is also a kind of Conferva from the dry bed of a rivulet which is filled after the eruption. Some mosses and lichens have been gathered on the summits of the mountains, and a fern, *Cystopteris fragilis* in the Almannegiaa, which is a rock where, in the older times, the Althing was convocated

every year. On the way from this side to the Geysers, the same fern is found in a cavern, or rather a hole in the mountain, called Reidarbarmer. Between this place to the hot-springs, we met with *Betula nana*, and another species of this genus, also an orchis, and two willows, and some other plants. This is, I dare say, the paradise of this part of Iceland, though the birches do not grow to a greater size than eight or ten feet at most.

As for the plants from Norway, I collected them in the environs of Bergen and Stavanger. It was too late (September) to find Phanerogams in flower, and for this reason I only gathered a few, but there are a greater number of Cryptogams. As we remained only for two or three hours on the Faröe Islands, I only gathered a few species which fell in my way. I hope that those specimens of the vegetation of northern countries will be agreeable to the Botanical Society of Edinburgh.

V. *Letter from* Mr William Milne, *dated Cameroon, Africa,* 27*th June* 1865. Communicated by Mr John Sadler.

Mr Milne alludes to the improvement which has taken place in Fernando Po and its vicinity, by the clearing of the ground and the planting of chocolate trees and cotton. By the end of this year one firm will have upwards of 100,000 cocoa trees above ground, and these plants will produce in 1867 about 500,000lbs. of cocoa. During the early stage of the plantation, cotton is planted among the chocolate trees. Coffee has also been extensively planted, and thrives well. Mr Milne alludes to the bark of a tree called Saricu. He says it is more rapidly fatal in its effects than the Calabar bean, and it is used as an ordeal poison by the natives. He alludes to the introduction of the mango, breadfruit, soursop, citron, tamarind, and other important plants into Calabar and the Gaboon. Mr Milne then gives an account of an excursion to the Cameroon Mountains, and notices some of the plants collected.

Mr Sadler read a note he had received from the Rev. Mr

Fraser of Colvend, regarding a tour which he had made in the island of Arran during last summer. Mr Fraser noticed the principal plants he had met with, and presented specimens of them to the Society's Herbarium.

Dr Greville noticed the occurrence of a rare fungus (*Sparassis crispa*) at Didlington Park, Norfolk, the seat of A. T. Amhurst, Esq., and showed a drawing of the plant of the natural size, made by Admiral Mitford of Hunmanby, Yorkshire. It is of a cream-white colour, and as large as a full-grown cabbage.

Professor Balfour exhibited several varieties of *Plantago maritima* collected on the mountains of Scotland, which seemed at first sight to resemble *Plantago alpina* of the continent. He stated that the characters of *P. maritima* and *P. alpina*, as given by De Candolle and Koch, seemed to be very imperfect, and it was not easy to determine the species by their descriptions.

11*th January* 1866.—Dr GREVILLE, President, in the Chair.

The following Gentlemen were duly elected resident Fellows of the Society:—

CHARLES GAINER, M.A., M.D.
ANDREW PATERSON.
SAMUEL CHAMPERNOWNE SADLER.

The following Donations to the Library were laid on the table:—

Annual Report of the Government Botanist and Director of the Botanic Garden, Melbourne.—From Dr Mueller.

Verhandlungen des Naturforschenden Vereines in Brünn, Band III.—From the Society.

The following Donations to the Herbarium were announced:—

From D. A. Watt, Esq., Montreal—Parcel of American Ferns.

From Dr Dickie, Aberdeen—Specimens of *Evernia prunastir* in fruit.

The following Donations to the Museum at the Botanic Garden were noticed :—

From Miss Wallace—Banksia Fruit from Madeira.

From G. B. Weston—Indian-corn, rice, and cotton, ripened in Canada.

From Mr Archibald Gorrie, wood-manager, Holkham Park, per Mr William Gorrie, Bangholm—Cones of *Picea Webbiana*, *Pinus excelsa*, and *Cedrus Libani*, fruit of *Pyrus Sorbus* and *Quercus Ilex*, ripened in Norfolk. Mr Gorrie writes as follows :—

"I subjoin more detailed particulars in regard to the cones, &c., which I lately sent you. They are all from Mr Archibald Gorrie, wood-manager to the Earl of Leicester at Holkham Hall, Norfolk. The Ilex acorns were grown there, as were also some fruit of the true service, *Pyrus Sorbus*, which, he states, 'should they arrive undecayed, you will find them very good indeed for eating.' They, however, arrived too much decayed for eating; but perhaps their seeds may be of use to you. The cones of *Picea Webbiana* are from a tree on the Earl of Leicester's neighbouring property of Fulmodeston, which has produced cones for several years, but not so large in size as those of the past season. It was planted in 1857, is now 27 feet high and 20 yards round the points of the bottom branches: a splendid object. At first it suffered much from late spring frosts, but not since it attained to about a third of its present height.

"The *Pinus excelsa* and *Cedrus Libani* cones are from Fornham Park, near Bury St Edmunds. The cedar from which they were gathered is a splendid tree, and more silvery in appearance than is usual in the Cedar of Lebanon."

The following Communications were read :—

I. *Notes on some African Lichens and Fungi.* By W. LAUDER LINDSAY, M.D., F.R.S.E., F.L.S. (Plate V. figs. 1 to 6.)

Attached to specimens of "Angola Orchella Weed," imported into London for the orchill and cudbear manufacture, and sent to me at various times by importers and manufacturers, I have frequently found fragments of the trees or shrubs on which the said weed—a species of *Roccella*—grows. These twigs are not such as to enable me to determine the

species of the tree or shrub to which they belong. Nor is this of much importance, so far as concerns the lichens, other than the *Roccella*, which grow thereon. But it is of some interest, if not importance, that we should know to a greater extent, and more precisely than we do at present, the species of trees that nourish the valuable *Roccellæ* (*R. Montagnei*, Bél. and *R. fuciformis*, Ach.), which constitute in great measure the "Orchella weeds" of commerce: which are imported largely from—the coasts especially of—Central Africa, and which generally occur (espècially *R. Montagnei*) on trees near the sea. These *Roccellæ*, which appear now to have completely superseded all other lichens in the home manufacture of orchill and cudbear, are as common on the east as on the west coast of Africa. Dr Kirk has favoured me with specimens of a large Everniiform state of *Roccella fuciformis* (with which I am disposed to associate *R. Montagnei* as a variety) growing on *Dalbergia Melanoxylon*, on the Rovuma river, about eight miles from the coast, in eastern tropical Africa (Zambesi Expedition); which resembles what now enters the London market as "Mozambique Weed."

On the same twigs affected by the *Roccellæ*, I find abundance of minute *Verrucariæ* and *Graphideæ*, with occasional *Parmeliæ*. Of the *Verrucariæ*, the commonest I find is a form of *V. epidermidis*, Ach., of medium size, closely resembling externally various states of the British and European plant (fig. 1). The perithecia are black and dimidiate, the upper half papillar, and seated *on* the bark; the lower immersed *in* the wood (fig. 3). In age, the upper half, or papilla, frequently or generally falls away, leaving a black saucer-like cavity, surrounded by an irregular black raised margin (figs. 2 *b*, 3 *d*). The *paraphyses* are filiform, sub-discrete, and agglutinated at their tips, which are brown, and sub tuberculated (fig. 4 *a*). The *thecæ* are broadly and irregularly saccate: 8-spored: ·0024″ to ·0030″ long, and ·0012″ to ·0015″ broad (fig. 4 *b*). Neither the thecæ, paraphyses, nor hymenial Lichenine give any reaction with iodine. The *spores*, which are numerous and distinct, are irregularly oblong, or oblong-ellipsoid: normally 1–3-septate: and colourless, or (the loculi) of a very pale yellow tint (fig. 5). In the young state of the spore only one septum is seen (fig.

5 *a*), more or less central, frequently dividing it into two halves of unequal size—a superior one broader and larger, and an inferior, narrower and smaller. Occasionally this 1-septate solæform condition remains till age, the spore then sometimes acquiring a brownish colour, with granularity of contents, and resembling the spore of *Abrothallus Smithii*, Tul. (fig. 5 *d*). There is generally a constriction at or opposite to the central septum. As the spores approach maturity, each of the two contained loculi or cellules—from which the spore wall or general envelope is very distinct, separated by a very considerable margin—divides into two, giving rise to the production of 4 cellules or loculi, and the appearance of 3 septa (fig. 5 *b c*). There is, however, seldom any constriction of the cell-wall opposite the secondary septa. Mature spores are usually from ·0015″ to ·0012″ long, and ·00045″ to ·0006″ broad.

Associated with this *Verrucaria*, Mr Currey has detected among my specimens a new species of *Sphæria*, whereof he has favoured me with the following specific diagnosis. I am glad of the opportunity of attaching to it the name of my old friend, the distinguished African explorer, Dr Kirk.

Sphæria Kirkiana.

Division—Obtectæ or Subtectæ. Perithecia embedded in the bark; subglobose; flattened at the apex; without any manifest ostiolum. Sporidia biseriate, brown (rather pale): mostly 7-septate; sometimes (I think) with longitudinal septa; usually 3 nuclei in a row in each partition: ·0014 to ·0016 inch (fig. 6).

References to Plate V. figs. 1–6.

Figs 1 to 5. *Verrucaria epidermidis*, Ach. var.
1. Natural size of twig and Verrucaria.
2. Latter—magnified.
3. Section of Perithecia and bark.
4. „ Hymenium.
    (*a*) Paraphyses.
    (*b*) Theca.
    (*c*) Hypothecial tissue.
5. Spores :—
    (*a*) Young.
    (*b*) Approaching maturity.
    (*c*) Mature.
    (*d*) Old.

Fig. 6. *Sphæria Kirkiana*. Spores (after Currey).

II. *On the Parts involved in the Process of Defoliation.* By W. R. M'Nab.

In the following paper are recorded the result of several observations made last summer with the view of verifying some of the statements made by Eichler * in a work on the development of leaves. While thus engaged, I was led to apply some of the facts thus obtained to an examination of the processes involved in the fall of the leaf, a subject which has not received that attention from physiologists that its importance demands. From the study of the development of the leaf we arrive at a more correct conception of its morphology, and are thus in a better position to examine its physiology. We shall first briefly consider the development of the leaf, and then apply the facts thus obtained to an examination of the fall of the leaf.

1. *General Phenomena of Leaf Development.*

It will be sufficient to consider the general phenomena of this process without entering into special details, and for this purpose we shall examine the stages of development as seen in such plants as the garden pea, tulip-tree, &c. Eichler has pointed out that there are two stages in the development: 1*st*, The formation of the *primordial blatt;* and, 2*d*, The evolution from this primordial blatt of the perfect leaf. The views of Eichler are thus directly at variance with those of Schleiden and his followers, who hold that the leaf is pushed out and developed entirely by the axis, the apex appearing first. The leaf, however, can be easily seen to be developed by the primordial blatt, or cushion-like projection from the axis, which is not the apex of the leaf. Naegeli held that the leaf was developed, not out of the axis, but by what he terms the "secondary cell of the first degree," a view more closely approaching that of Eichler.

The primordial blatt is developed from tho axis in dif-

* Zur Entwickelungsgeschichte des Blattes. Von Dr A. W. Eichler. Marburg, 1861.

ferent ways; but in whatever way it appears, they all go on till they reach a certain stage. At first the primordial blatt appears as a mamilla, or cushion, or ring, separated from the axis, which becomes differentiated into two parts, called by Eichler the "unterblatt" and "oberblatt." Here we may consider the first stage to end. The second stage consists of the evolution of the different parts of the perfect leaf from this primordial blatt, and not, as is supposed by Schleiden, from the axis. We may, perhaps, call the primordial blatt of Eichler either the primordial leaf, or perhaps, more correctly, the *phylloblast.** The phylloblast, as we have just seen, divides into two parts, called respectively by Eichler the "unterblatt" and "oberblatt," or, as we may term them, the hypophyll † and epiphyll.‡ The hypophyll is the lower part of the primordial leaf; it is nearest the axis, and is almost stationary in most plants, never proceeding far in development, and hence very difficult to trace in the fully developed plant, although distinct enough in the early stages of development. The epiphyll is the more distant part, separated from the axis by the hypophyll, developing rapidly and out of all proportion to the lower part. From any part of the hypophyll the stipules are developed, while the epiphyll developes the lamina and petiole. We must, therefore, consider that the leaf is the entire product of the development of the phylloblast, and consists of two parts: an axial or proximal part, the more or less developed hypophyll; and free or distal greatly developed part, the epiphyll. The hypophyll may be large or small. It is attached permanently to, and separates the lamina and petiole from the axis of the plant. Any part of its surface may produce the appendages called stipules, and in all cases they are produced as appendages of the hypophyll. The lamina and petiole are produced by the epiphyll. Both may be developed, or either one or other may be wanting; and, lastly, the sides of the petiole may become winged, or have leaf-like appendages.

There appears to be no exception yet observed to the mode of development just described. It seems to hold in all cases yet observed that, 1*st*, There is a phylloblast

* Phyllon. Blastos. † Hypo-phyllon. ‡ Epi-phyllon.

produced from the axis in one or other way described by Eichler; 2*d*, That the phylloblast differentiates itself into two parts, the hypophyll and the epiphyll; 3*d*, That the hypophyll, or lower part, developes from any part of its surface the organs called stipules; and, 4*th*, The epiphyll developes the parts of the leaf proper, the lamina and petiole. The general idea of a leaf is thus not a complete one, it being generally considered as consisting of the lamina and petiole, with the stipules as appendages of the petiole. We see, however, that the lamina and petiole form only part of the leaf developed from one part of the original phylloblast, while the stipules are developed from another and equally important part of the phylloblast. It is thus owing to our imperfect conception of a leaf that much confusion exists in the nomenclature and supposed relations of the different parts of a leaf.

2. *On Defoliation.*

In the foregoing statements we have pointed out the general phenomena observed in the process of phyllogenesis. From what has been said, we must conclude that the stipules are not parts of the petiole, but are produced from the edges of the lower part of the phylloblast, and that the lamina and petiole are developed from the upper part of the phylloblast, and not, as has been held by some authors, directly from the axis. It thus follows that the generally received opinion that the petiole is inserted into the axis directly is incorrect, because we have the more or less developed hypophyll, bearing or not the stipules between the petiole and the axis. If, then, the leaf falls off and leaves the stipules attached to the stem, the whole leaf has not fallen off—part bearing the stipules, the hypophyll, which is in general closely incorporated with the stem, still remains. Hence the stipules may and do fall off, quite independent of the lamina and petiole. No attempt has been made by botanists to prove that the separation of the leaf was other than a separation between axis and leaf, as the existence of the hypophyll has only been pointed out recently by Eichler. He, however, only considers the development, and does not place any physiolo-

gical importance on it. Let me now endeavour to show that what has been just stated does really occur.

Dr Inman * has published a paper "On the Causes that determine the Fall of Leaves." In this paper he clearly points out the changes that occur in the cells of the plant before the separation takes place, but he does not remark that the separation is other than between leaf and stem. It would be out of place here to examine the changes taking place at the part; we shall merely refer to Dr Inman's paper for full information.

If we select what we may consider a typical leaf, to examine the defoliation, we must take a leaf with lamina, petiole, and stipules. The leguminosæ furnish us with numerous examples. Let us take as examples, *Mimosa*, *Cytisus Laburnum*, *Desmodium*, and *Glycyrrhiza*. In these we observe that the separation takes place immediately below the pulvinus, which is the swollen base of the petiole, and that the stipules either remain after the leaf has fallen off, or else have withered at an earlier period, and left cicatrices attached apparently to the stem, but which, as we have seen by the development, must be the hypophyll adherent to and part of the axis. Here, then, we find that the entire leaf, as we have defined it, does not fall off; that only a part of it is deciduous, and that only the free part, or lamina, and petiole—the developed epiphyll—while the axial part, or hypophyll, with or without the stipules, is a part of, and is adherent to, the axis of the plant. In Erythrina the separation takes place below the pulvinus, the stipules falling off very early. The Liriodendron affords a good example of the process. The scar of the stipule surrounds the axis; but the stipules cannot be produced directly from the axis, but can be seen to be developed from a circular phylloblast, on one part of which an epiphyll is produced. If we examine the leaf produced last in autumn, we find that the stipules act as the perulæ, or protecting coverings of the young bud, and do not fall off till spring, while the leaf has been detached in autumn as usual. The *Cytisus Laburnum* offers a sort of exception to the general rule. The separation takes place as usual: the stipules are left attached to a large cushion. This remains

* Proc. of Lit. and Philos. Soc of Liverpool, vol. iv. p. 89.

for a long time, but is ultimately thrown off to accommodate the rapid growth of the stem. It is, however, more an apparent than a real exception. If we can accurately determine the point of separation in plants where the parts are typical and well marked, there will be no difficulty in applying it to others in which the parts are not so well marked.

In the Mimosa the stipules remain attached to the stem after the leaf has fallen off. In the Desmodium they fall off early, but leave a well-marked scar; while in Glycyrrhiza they fall off early, and leave scarcely any mark. The stipules of these three plants are free, and may be considered typical, but adhesion of the stipule to the petiole —if this can be considered to take place in the Rose— does not alter the case, because the stipules, instead of falling off either before or after the leaf, will, in virtue of their adhesion, fall off with the leaf; and we have no reason to suppose that although the appendages of the hypophyll adhere to and fall off with the epiphyll, that therefore the hypophyll itself falls off. Eichler, however, considers that although stipules may adhere together as in Cinchona, &c., forming what he calls adnate stipules, yet he excludes the Rose from this group, and prefers to consider the part to which the stipules are attached as a very much enlarged hypophyll, and the petiole as only beginning where the stipules end. If we adopt Eichler's hypothesis then, the Rose offers an exception,—the separation not being between hypophyll and epiphyll, but really between axis and leaf; as ultimately takes place in the Laburnum. But if we take the old view of the matter, and consider that the adnate stipules may be those that adhere either to each other or to the petiole, then it is no exception. In most of the plants examined the separation took place immediately below a swelled portion, which is the pulvinus, and it is therefore to be considered as being the swollen base of the petiole, and marking the place of attachment of the epiphyll to the hypophyll. If we assume this to be the case, then, in plants without stipules, as, for example, the horse-chestnut, if the separation occurs immediately below this swelling, then the hypophyll, being only slightly developed, and therefore almost indistinguish-

able, cannot be said not to exist, as we know the petiole is not inserted directly into the stem. It is in this manner that we hold that those plants which are extipulate offer no exception to the rule.

From what has been said, it will be seen that the articulation which takes place between the hypophyll and epiphyll (as we have tried to show, really occurs, and causes the detachment of the leaf at that part) is a definite spot predetermined from the earliest stages of development. This spot is marked externally, as shown by Dr Inman.* He says, "If we examine when the shoots are young and vigorous in the early spring, we shall find that there is a faint line externally that marks the position of the future joint, but that internally there is scarcely any indication of its existence." The separation is also, as we have tried to show, not a separation between axis and leaf, as it is generally considered to be, but between the axial part and free part. The part which falls off is the entire product of the development of the epiphyll, namely, the lamina and petiole, while the hypophyll remains attached to the plant. The division begins and is determined from the earliest stages of growth, and goes on gradually till the process is complete, and is no doubt assisted by "the choking up of the cells and vessels of the leaf by the deposit of earthy and saline matters in consequence of the absorption in autumn not keeping pace with the exhalation of watery fluid."† The length of time required to form the separation determines the duration of the leaf—its non-occurrence causing persistence.

The views here put forward differ from those generally received,—that the leaf, as a general rule, separates from the *axis* when it falls off. Schleiden, who held that the leaf was developed immediately from the axis, says‡ that, "in *Dicotyledons*, a joint is formed between the leaf and the axis, in consequence of which the leaf is, after a certain time, thrown off from the axis," &c. From all that has been said, it is evident that the cushion-like part of larger or smaller size left by the fallen leaf is considered the hypophyll. This part, in general, supplies the cicatrix. The cushion

* *Loc. cit.*, p. 90. † Balfour's Class Book, p. 501.

‡ Scientific Botany, p. 267.

contracts somewhat, and a barky layer covers in the whole —thus covering a part of the leaf, and incorporating it with the axis.

In dicotyledonous stems the hypophyll is so small as not to be easily made out on microscopic examination. In monocotyledons the same holds. The absence of stipules in general may be considered the reason of the slight development of the hypophyll. In stems of certain acrogens, as tree ferns, we have the bases of the fronds entering into and forming part of the stem. Is this exceptional, or is it the same as occurs in the monocotyledonous and dicotyledonous stems? Let us assume the frond of a fern to be the homologue of the leaf of a dicotyledon. It is certainly a much less differentiated organ than the leaf of a dicotyledonous tree, because we have *one* leaf so modified as to subserve not only the processes of nutrition, as in the leaves of dicotyledons; but also to furnish the reproductive organs, which in phanerogams is done by specially modified leaves. This leaf or frond, if it follows the same law as the phanerogams, will leave a more or less developed hypophyll attached to the stem. If, then, the fern stem be made up of the hypophylls of the different fronds or leaves, it is no exception to the structure of other stems, in so far as part of the leaf enters into its construction. In the fern, however, instead of the hypophyll being very small and hardly traceable, it is the larger part. There is thus no real difference between the stems of the dicotyledon and monocotyledon and the acotyledon, except that in the one we have one part largely developed, and the other hardly traceable—while in the acotyledon the reverse occurs, and the imperfectly developed part becomes very largely developed, forming the greater part of the stem, while the other is reduced to a minimum.

III. *On Cinchona Cultivation in Ceylon.* By Mr Clements Markham. Communicated by Dr Greville.

Mr Markham, of the India Office, has been deputed by the Government to visit the planters along the western coast of India, and try to induce them to cultivate the

cinchona tree, in order that a new source of supply of quinine may be obtained. He has been visiting and reporting on the Hakgalla Cinchona Plantation, in Ceylon. He says that the site at Hakgalla is well chosen, as closely resembling the habitat of the plants in South America, and he bears testimony to the skill and success with which Mr M'Nicol has conducted the task of cultivating and propagating the quinine-yielding plants. Of the many thousands planted out on a bare slope at Rothschild, exposed to the full influence of light and wind, he also speaks in the highest terms as robust and flourishing. He states that the Cinchonidæ in India are pretty certain greatly to excel the parent plants in South America in the yield of valuable alkaloids. So striking is the improvement, indeed, that what are reckoned inferior species in the country to which they are indigenous, vie in their products with the most valuable. It has been proved that not only do the young prunings yield large quantities of quinine, but that by encouraging the growth of moss and lichens on the stems, the quantity of alkaloids is increased; and more than this, that if the wounds are at once covered over by moss, strips of bark, rich in the most valuable of febrifuges, can be repeatedly taken from the same trees without injury to their vitality. Every encouraging element, as far as cultivation is concerned, is therefore present; and to complete the inducements to the Ceylon planters to engage in the pursuit, there will be a market close to their doors. The Government of India, the largest consumers of quinine in the world, are about to establish a manufactory for obtaining sulphate from the bark in the Madras Presidency. Mr Markham, looking at the Rothschild plants, believes that they will yield results as favourable as those obtained from specimens from the Neilgherries, and these have been most favourable. In 1863 specimens were sent to Mr Howard when the sap was beginning to rise. The analysis gave 2·4 per cent. of quinine, and elicited from Mr Howard the opinion, that the cutting should take place as soon as the bark was thick enough to repay cultivation. A second specimen taken with the sap in full flow gave 5 per cent. of purified alkaloid. Then came Dr de Vry's analysis of a specimen of *Cinchona micrantha*, thickened with moss,

which gave the hitherto unprecedented yield of 8·4 per cent. of alkaloids. The third analysis by Mr Howard was of bark taken in February 1864, when the trees were at rest. The result was most favourable, and led to the decision that February was the best time to cut the branches. In April 1865, bark thickened by moss, stripped from a stem three years and five months old, was analysed both by Mr Howard and Dr de Vry, and gave results, commercially and in a medical point of view, far superior to anything obtained from American bark. Dr de Vry's analysis showed the astonishing percentage of 11 of alkaloids. The red bark of India and Ceylon will fetch as high a price as the Calisaya of Bolivia, the most valuable of all the barks (4s. per pound). If the price went down to one-fourth of this sum, we have little doubt the cultivation would pay. The bark could either go to India, or it would be taken at a cheap rate to England as filling up cargo. Mr Markham says, "There is another point to which I think it particularly important that the attention of the Government of Ceylon should be directed. There are four febrifuge substances in cinchona bark, found in larger or smaller proportions, according to the species. These are quinine, quinidine, cinchonidine, and cinchonine. At present, the first of these is alone of great commercial value. Yet it is the opinion of the most eminent chemists in Europe that quinidine and cinchonidine are of nearly equal efficacy, while cinchonine is by no means devoid of febrifuge virtue. The presence of these alkaloids other than quinine is at present, therefore, a disadvantage in a commercial, but not in a medicinal point of view; and looking at the large yield of cinchonidine in our *Cinchona succirubra* and of quinidine in our *C. micrantha* plants, it becomes a matter of the utmost importance to clear away the prejudice and error on this point. Cinchonidine, I may remark, was undoubtedly the therapeutic agent in the famous cure of the Countess of Chinchon in 1639, who gave her name to the genus, and its febrifuge value has been recognised by the late Dr Royle, M. Briquet (the eminent French quinologist), Mr Howard, and Dr de Vry. The true position of these febrifuges may be established by appointing commissions consisting of medical men to re-

port upon them ; and with this view, the Secretary of State for India has issued instructions, in a dispatch to the Madras Government, dated September 30, 1865. From that dispatch it will also be seen that it is contemplated to establish a manufactory of some cheap form of the cinchona febrifuge in India. The enterprise is a very important one, and likely to advance the prosperity of the colony, and to prove a material blessing to its inhabitants." Mr Markham concludes by suggesting a periodical analysis of bark actually grown on coffee estates at an elevation of 3000 to 4000 feet, to enable cultivators to see their way; and by expressing his admiration of the zeal and ability with which this great undertaking has been conducted by Dr Thwaites and his assistant, Mr M'Nicol, and at the thorough efficiency of the plantation at Hakgalla, which so completely secures the objects contemplated by the Government. Not half a dozen years have elapsed since the first plants were introduced into India, and now they are to be found, to the number of at least a million and a half, scattered over the hill ranges of Ceylon and India, from Hagkalla to the Himalayas—flourishing everywhere except in hill hollows, where actual frosts prove fatal to them. That our estimate of the number of cinchona plants in Ceylon and India is not too high, is evident from Mr M'Ivor's report for the twelve months ended April 1865. Government state, in their resolution on the subject—The average monthly increase in the number of plants by propagation was 21,200, and the total number of plants on 1st May 1865 was 558,105, exclusive of 78,612 plants issued to the public; so that 558,105 + 78,612 = 636,717, was the number of plants on the Neilgherries up to 1st May. Add 140,000 to date, at the rate of 21,000 increase per month, and we have 776,000 plants for the Neilgherries. The Ceylon report showed 515,000 up to August. We may say 550,000 now. So that we get—plants in Ceylon, 550,000; plants on the Neilgherries, 776,000 ; total, 1,326,000. The estimate of 1,500,000 must be fully made up by the plants scattered over some twenty other stations in India and the Punjab. Ootacamund is the seat of the great experiment, and the spot where Sir Charles Wood has decided that the manufactory shall be carried on. There the Government

have large plantations of their own. An additional area of 184 acres has been planted during the season, and a further area of 373 acres is under preparation. The total extent planted is 507 acres—viz., Neddiwuttum, 284 acres; Pykara, 71; and Doddabett, 152. The total cost of the operations up to 30th April 1865 was 212,602 rupees for establishment, buildings, plantations, roads, tools, and sundry contingencies. The Government consider that the progress in the operations has been very satisfactory, and they congratulate Mr M'Ivor on the important success that has attended his labours in this national undertaking. The oldest plants, which were planted out in August 1862, are now from 8 to 12 feet in height, and from 7 to 13 inches in girth at 6 inches from the ground, well furnished with lateral branches, and present a most robust and healthy appearance. The analysis of the barks has exhibited a further increase in the yield of alkaloids—Mr Howard having obtained 6 per cent. of purified alkaloids, while Dr de Vry found in one specimen as much as 8·49 per cent. of alkaloids, being fully five times the average quantity found in the barks of commerce. In the oldest plantations the branches of the plants 10 and 12 feet apart are now touching each other, and the bark has much increased in thickness. The characteristic markings of the finest Peruvian bark are becoming more and more apparent, lichens and mosses being fully developed. The plants are flowering freely, and perfect seeds have already been obtained; in short, there is no room to doubt the cinchona can be grown on the Neilgherries to as great perfection as in the most favourable localities in which it has been found; and the "crown" bark species is found to do well in almost every soil in the plateau of the hills, in grass land as well as in forest, so long as land-locked hollows are avoided, in which it suffers from frost. Before five years more are over, we trust the anticipations of the Secretary of State for India may be realised, and that the most valuable of febrifuges may be brought within the reach of the poorest of the population. The benefit to humanity from the now assured success of the grand experiment will be incalculable.

IV. *Notice of Plants collected during a Tour in Ireland in* 1865. By F. Naylor, Esq.

Mr Naylor noticed the various places visited and the principal plants collected during his tour. Among the plants met with were—*Dabœcia polifolia*, *Erica mediterranea* and *E. Mackaiana*, *Saxifraga hirta*, and various species of the Robertsonian Saxifrages, *Eriocaulon septangulare*, *Pinguicula grandiflora*, *Cyperus fuscus*, *Trichomanes radicans*, *Adiantum Capillus-veneris*, &c. Specimens were exhibited.

V. *Report on the Flowering of Plants in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Mr M'Nab stated that, perhaps during no previous season were we ever permitted to give such a list of plants as were seen in flower in the open air on the 10th of January this year—amounting to no less than fifty-one species. This is to be ascribed to the extreme mildness of the weather during the past three months. From the beginning of October up to this date, only on eighteen mornings did the thermometer fall below the freezing point—the lowest being on the 6th, 7th, and 13th of November—each morning indicating 24°. On 15th December it stood at 26°; on 23d October and 14th November at 27°; on 26th October, 29th October, 5th November, and 11th December, at 28°; on 16th November, at 29°. On the other six mornings it ranged between 30° and the freezing point. Many of the summer bedding-out plants, in the open air, were up till yesterday in a free growing state—such as scarlet geraniums, verbenas, calceolarias, &c. Many plants are rarely to be seen so far advanced in growth as they are at this time. Roses, although producing flowers more or less throughout the winter, have in numerous instances young shoots averaging from one to four inches in length. The *Jasminum nudiflorum* was scarcely ever known to have flowered so profusely as it has done this winter. The Chinese chrysanthemums on open walls have this autumn

flowered themselves done, instead of being injured or killed as they generally are while in bloom. Wallflowers and intermediate stocks have been particularly full of bloom up to this time, all produced from autumn-made growths. Besides annuals, which of late have been growing freely and flowering profusely, some perennial herbaceous plants have made remarkable shoots, the most conspicuous being the *Helleborus fœtidus*, in which the new made flowering tops have already pushed ten inches and are in bloom. Of the other plants which have grown freely are the common cardoon (*Cynara Cardunculus*) and the cow parsnip (*Heracleum giganteum*); on both of these plants the leaves have grown from ten to twelve inches. Numerous plants have made new growths, varying from four to six and eight inches, such as the fennel, evergreen bugloss, woad, comfrey, oriental poppy, alpine dock, and the common day lily. Grasses and sedges have been advancing; of these the tall Fescue grass has made leaves eight inches in length. Amongst the British weeds we have numerous examples in flower, such as the daisy, dandelion, groundsel, sorrel, clover, and chickweed. The thermometer this morning fell to 20°, being 12° below the freezing point; and many of the plants which were in flower yesterday have now got a check, and every appearance of vegetation being thrown back.

Mr M'Nab then gave the following list of the plants in flower in the open air at the Royal Botanic Garden on 10th January, amounting to fifty-one species.

Alnus cordifolia
Anchusa sempervirens
Andromeda floribunda
Aponogeton distachyon
Arabis albida
Centranthus macrosiphon
Cheiranthus Cheiri
Corylus Avellana
Cotula aurea
    minima
Crocus susianus
Daphne Mezereum
Doronicum caucasicum
Erica herbacea
Garrya elliptica
Gentiana acaulis
Helleborus abschasicus
    fœtidus
    niger
        grandiflora
        major
    odorus
    orientalis
    purpurascens
    viridis
Jasminum nudiflorum
Knappia agrostidea
Lonicera implexa

Leptosiphon androsaceus
Leucocoryne alliacea
Limnanthes grandiflorus
Matthiola incana
Phlox verna
Potentilla alba
Fragariastrum
Primula elatior
vulgaris
Pyrethrum Parthenium
Rhododendron atrovirens
Nobleanum
Ruta graveolens
Sisyrinchium cœlestinum
Symphytum caucasicum
Tritoma media
Tussilago nivea
fragrans
Valeriana congesta
Veronica salicifolia
Viburnum Tinus
Viola odorata
tricolor

Mr Gorrie exhibited flowering specimens of *Tussilago fragrans*, collected in the neighbourhood of Edinburgh in a naturalised state; also twigs of *Taxodium sempervirens*, bearing flowers and cones.

Mr Traill, Aberlady Lodge, stated that, in proof of the mildness of the season, he had gathered a dish of the common mushroom (*Agaricus campestris*) on 24th December last.

Dr Dyce Duckworth writes:—"I send some diseased leaves which I collected in J. J. Rousseau's garden, near Chambery, in September last. They are from pear trees. There was a great amount of disease, and the fruit was much deteriorated in consequence of it. Some of the minute insects are still on the leaves, dead of course, and the surfaces of the laminæ are covered with their excrement. There are two curious excretions, one on each leaf, which remind me of the modified growth occurring in pines subject to the *adelges* insect."

Mr R. M. Stark exhibited specimens of several interesting varieties of American ferns, which he had lately collected in Canada.

Professor Balfour presented a portrait of the late Professor John Lindley.

9th February 1866.—Professor ARCHER in the Chair.

The following Donations to the University Herbarium were announced:—

From the Rev. H. W. Wood—Specimens of *Lophodium glutinosum* and *Elatine hexandra.*

From Dr Buchanan White—Specimens of *Cuscuta Trifolii*, collected near Perth, and several rare British mosses.

From Mr C. Howie—Specimens of *Pottia crinita*, gathered near Duddingston.

From Professor Wilson—about 300 portfolios of plants interesting in agriculture.

From Mrs Milne—Specimens of *Leptodon Smithii.*

The following additions to the Museum at the Botanic Garden were noticed:—

From Mr Gorrie—Fruit of American beech.

From Mr P. S. Robertson—Fruit of *Terminalia Chebula.*

From Mr M'Nab—Fruit of Doom-palm.

From Professor Balfour—Fruit of prickly pear (*Opuntia vulgaris*).

The Secretary laid on the table letters of thanks which he had received from the following gentlemen for their election as Honorary or Foreign Members:—George Bentham, Esq.; Charles Darwin, Esq.; Dr J. D. Hooker; Professor Daubeny; Professor Babington; Professor Harvey; M. Miquel, Utrecht; M. Grisebach, Göttingen; Professor Clos, Toulouse; M. Fee, Strasbourg; Dr Schnizlein, Erlangen; M. Casimir De Candolle, Geneva; M. R. Caspary, Konigsberg; M. Naudin, Paris; Dr Nylander, Paris; M Agardh, Stockholm.

Professor Balfour noticed the death of Jean François Camille Montagne, an honorary member of the Society. He was born 15th February 1784, and died 9th January 1866. He was a distinguished cryptogamic botanist, more especially in the department of fungology.

The following Communications were read:—

I. *On Plant-Epidemics in relation to Epidemics in Man and Animals.** By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S.

The history of Epidemiology shows that epidemic disorders of plants frequently, if not generally or always, precede, or are contemporaneous with, those of animals and man; and the inference seems legitimate that they are, in such cases, equally attributable to the action of that mysterious atmospheric poison, which apparently generates such diseases as Cholera and Rinderpest. It is probable that the present Rinderpest and the coming Cholera may be, in this respect, no exceptions to the general rule, if only observation is sufficiently on the alert. In relation to the devastating epidemics of man and animals, those of plants are of no small importance; for the scarcity, or inferior quality, of staple food—vegetable food—(such as potatoes or the cereals) prepares the way for the full and speedy action on man and animals of those insidious volatile atmospheric poisons, which appear equally to affect animal and vegetable life.

So early as the middle ages these facts appear to have been fully recognised. Dr Chambers remarks of the Plague in Scotland,—" While there are several instances of famine not followed by the pest, there was *scarcely one instance of the pest, which was not immediately preceded by a famine.* So far the opinion of modern medical writers, that deficient nutrition in the community is one of the predisposing causes of pestilential fevers, may be considered as borne out by facts."† Hecker,‡ again, mentions various epidemics of

* Some writers are in the habit of speaking of *Epizöotic* and *Epiphytic* diseases as the equivalents or analogues, in the lower *animals* and in *plants*, respectively, of that class of diseases which is usually termed *Epidemic* in man. The two former designations are, however, liable to misconception: especially the term *Epiphytic*, which is for such a purpose loosely and incorrectly applied. It is much more accurate and satisfactory, therefore, to use the general term *Epidemic* for the class of diseases referred to, whether in man, the inferior animals, or plants.

† " On the occurrence of the Plague in Scotland during the Sixteenth and Seventeenth Centuries." By Robert Chambers, LL.D. *Proceedings of Royal Society of Edinburgh*; reported in *Edin. New Philosophical Journal*, January 1856.

‡ In his " History of the Epidemics of the Middle Ages."

the middle ages as ushered in by the prevalence of certain Moulds, such as red fungi, which were popularly regarded as "blood spots," and as "signacula" of the coming pestilence. The connection of *fungi* with the causation of epidemics, equally in man, animals, and plants, is a theory that has found favour from the middle ages to the present time; and though we now possess a considerable list of diseases in man, animals, and plants, in which fungi play an important part, it is yet doubtful whether, in the case of epidemics at least, their presence is not merely *a result, instead of a cause*, of the original disease. The sudden appearance of such diseases as the potato or vine blights in healthy, previously unblighted, districts; their equally sudden disappearance; their apparent independence of the natural barriers of climate or latitude, as well as of the artificial barriers interposed in the form of measures adopted for the prevention of their dissemination, are circumstances that seem to warrant us in placing these epidemics of plants in certain respects in the same category with Cholera or Rinderpest.

During the epidemic of yellow fever at New Orleans in 1854, it was recorded by one authority, that "his cauliflowers, cabbages, and radishes would wither and die;" and by another that his fig trees did not produce so "many figs as usual."* The Rev. Alex. Allan—writing from the Old Manse of Eassie in the "Dundee Advertiser," of February 21, 1866—connects the present cattle plague with a "*terrible mildew* we had during the autumn months, when the whole potatoes, as well as the turnips, were covered with it." An epidemic in sheep, in Forfarshire in March 1866, reported to be Rinderpest by Professor Dick and other competent veterinarians, was attributed, by a commission of cattle-dealers and stock-owners, who examined the animals and the circumstances of their attack on the spot, to eating *mildewed* turnips. It does not follow that the fungus—the mildew—was the cause of the disease, or that the latter would not equally have been produced had the sheep had unexceptionable food. But the coincidence is sufficiently striking to render

* "Yellow Fever." By Dr La Roche. Philadelphia, 1855. "Report of the Sanitary Commission of New Orleans on the Epidemic Yellow Fever of 1853." Both reviewed in *Brit. and For. Medico-Chirurgical Review*, Oct. 1856.

it worth while to examine how far the disease was a *propter*, or only a *post*, *hoc!*

Instances such as these are of course unimportant in *determining* what is the action of the *epidemic constitution* of the air on vegetation; for such results may be mere coincidences, and might equally have occurred under other conditions. Still a full record of *all such coincidences* would go far to enable us to deduce general conclusions as to whether or not what we conveniently call the *epidemic constitution* of the atmosphere during such diseases as Cholera and Rinderpest, has equal effect on vegetable and animal life.

I do not, however, here propose, on the one hand, to give detailed illustrations of the diseases of plants, which have preceded, or been coincident with, former epidemics of man and animals in different parts of the world; nor, on the other, to enter on the particulars of the kind of observations which are at such a crisis as the present (in regard to Rinderpest and Cholera) desirable. For both these classes of details I must refer those interested to papers formerly presented to this Society, or published, by me.*

II. *Notes on a Botanical Tour through Canada in* 1865. By Mr R. M. Stark.

Mr Stark gave an account of several trips made by him in Canada during the summer and autumn of last year. These consisted of excursions to Montreal, Ottawa, the shores of the Georgian Bay, and Niagara. He enumerated the most remarkable plants found by him, amongst which were species of Cypripedium and other terrestrial orchids, Asclepias, Lilium, Trillium, Uvularia, Erythronium, &c. Some interesting facts were also given regarding the geographical distribution of several of these plants over the country, and of the prevailing weeds, most of which seemed to be of European origin. Several of the rare American ferns, and their varieties, were also noticed. Mr Stark stated that he had secured living plants of all the principal species. The paper was illustrated by means of dried specimens and water-colour drawings.

* "Suggestions for Observations on the Influence of Cholera and other Epidemic Poisons on Vegetation." *Proceedings of Botan. Soc. of Edin.* 1856, p. 25. "The Epidemic Diseases of Plants (also in relation to the Cholera Poison)." *Association Medical Journal*, 1854, p. 1110.

III. *Notice of a Tree found in a Peat Moss in the Island of Shapinshay, Orkney.* By Mr Alexander Buchan.

Four specimens of what appeared to be trees were sent to Mr Buchan from a moss in Shapinshay by Mr Balfour of Balfour. Two of these, however, on close examination, were found to consist simply of decayed sphagna, grasses, heath, and other bog plants. The other two were wood, one being part of a stem about 2 or 3 feet in diameter. They had both the same structure, and, as far as could be determined from their decayed condition, were probably oaks. Mr Buchan was not able to say, from the information he had received, whether the two trees were found *in situ.* He mentioned that some years ago Dr Baikie had found an oak tree in the same moss about 4 feet in diameter, with part of the branches and root still attached, thus showing, in an unmistakable manner, that it had grown on the spot. After a great storm a considerable number of birch-tree stumps were discovered under low-water mark in Skail Bay, in the west of Mainland, still standing *in situ*, the violence of the storm having swept away the sand which had previously covered them; and about the same time a similar discovery of submerged trees was made in a bay to the north of Shapinshay. Hence it is manifest that Orkney has not always been the treeless region that it now is, but that at least oaks and birches of considerable dimensions had once grown there. The author then referred to the relations existing between the physical features of Orkney and its climate. He stated that the hilly country in the west of Mainland possessed a damp and rainy climate, as is the case in the west of Scotland; but that to the east of the high ground the climate was drier and the rainfall less, being in Shapinshay very little more than the rainfall of Edinburgh. It is in this latter district that most of the trees have been found, and it is probable that trees might still be grown with some success in this comparatively dry climate. Referring to the effect which would follow if Orkney was joined to Scotland in increasing the cold of winter and the heat of summer, and thereby producing a climate better suited to the growth of trees, he inferred the probability of Orkney

being united to the mainland of Scotland at the time when such large trees as those to which he had referred grew in Shapinshay.

IV. *On the Development of Leaves.* By William Ramsay M'Nab.

In a former paper the general process of leaf-development was examined, and an attempt was made to apply the principles thus obtained to an examination of the process of defoliation. In the present paper we shall consider the development of what we called in the former paper the phylloblast, and the evolution from the phylloblast of the stipules, lamina, and petiole. In other words, we shall briefly examine the development of the different forms of leaves and stipules.

1. *Modes of Formation of the Phylloblast.*

We have described the phylloblast as being the small cushion or mamilla which is developed from the axis, and produces the leaf. The phylloblast may develope from the axis in various ways; of these two are noticed by Eichler,* but there seems to be a third, which presents certain differences from the other two, and which we shall describe here. The third mode occurs in certain plants, as the Labiatæ, with square stems and opposite leaves, and is, I think, sufficiently different to warrant our making it a distinct type. By all those modes of development the phylloblast reaches a certain stage, when it divides into the hypophyll and epiphyll, and then from these two parts the perfect leaf is developed.

The first may be thus described:—A small cushion appears immediately underneath the growing point of the axis, of a size corresponding to that of the insertion of leaf and stipules when full grown. The phylloblast thus appears at once occupying exactly the proportion of the axis that the perfect leaf, *plus* the stipules, will require. Thus the phylloblast may appear as a ring or as a semicircular cushion, according as the leaves may be opposite, or only occupying one-half of the axis. In the Galium and Rubias,

* Zur Entwickclungsgeschichte der Blattes, p. 7.

&c., we have a ring; in Hippuris, again, we have a number of small projections; and in other cases, if the leaf occupies one-third or two-thirds of the stem, then the phylloblast is developed at once of the proportional breadth. In opposite leaves we have a circular cushion, as in Acer, Galium, Rubia, Coffea, &c., and it is in this particular that the Labiates differ, having opposite leaves, but the two occupying only one-half the stem.

In the second mode of development we have the following:—The phylloblast appears at first of very small size, bearing no relation to the breadth of insertion of the perfect leaf; but it rapidly develops to both sides, until the space covered is exactly equivalent to the insertion of the leaf, and is in every respect similar to the phylloblast, developed in the other type. The broadening out always takes place before the phylloblast shows any division into hypophyll and epiphyll. This type may be seen in the Ranunculaceæ, Rutaceæ, Umbelliferæ, Rosaceæ, &c.

The third mode is intermediate between these two types. The relation of the leaves to the stem in the Labiatæ is sufficiently peculiar. We have square stems, the leaves opposite, but the bases of the two only occupy altogether half the stem, the other half, or two quarters, being uncovered. This form agrees with the first in the phylloblast appearing at once of the breadth occupied by the perfect leaf, but it differs in the fact, that all the opposite leaves of the first type were developed from circular cushions, and that the half of the phylloblast developed the leaf and its stipules, if the leaf possessed stipules. In the Labiatæ we have opposite leaves, developed from two separate phylloblasts, and not a circular one, these two occupying only one-half, or rather two quarters of the circumference of the axis. The leaves of the Labiatæ are destitute of stipules, which might have occupied this missing part of the phylloblast. This may account for the apparent exception; but the peculiarity of the stem and leaves of these plants is, I think, sufficient to warrant us in considering them, if not as a separate type, at least as a sub-type.

By these ways the phylloblast proceeds to a certain stage, and then it begins to exhibit traces of further development, by differentiation into two parts. These two parts have

been noticed in the leaves of all phanerogams yet examined. The first is the stationary, the second the vegetative part; and these we have already denominated the hypophyll and and epiphyll. The hypophyll forms the basal part, is in many cases of considerable size, and occupies the entire lower part of the phylloblast. In some plants, and more particularly in monocotyledons, it is reduced to a very small size. This lower stationary part can develope from its margins or any part certain leaf-like structures (stipules). The upper border of the hypophyll forms the base of the epiphyll. From this upper part are developed the lamina and petiole. It is thus obvious that the petiole is not attached to the axis directly, but is separated from it by the hypophyll. The leaf is also not developed directly from the axis, but is developed entirely from the phylloblast.

2. *Development of the Epiphyll.*

The development of the epiphyll resolves itself into two processes—first, the formation of the lamina; and, second, of the petiole. Both these parts are not necessarily developed; there may be an arrest of growth, causing a non-development of one or other. The sessile leaves are examples of the arrest of development of the epiphyll, with absence of the petiole. We may, perhaps, here briefly consider the question of phyllodia, as examples partly of the arrest of development of the epiphyll. There appear to be two distinct kinds of phyllodia, in so far as there is a slight difference in the parts concerned. For example, in the Oxalis, we have the petiole alone forming the phyllodium, but the acacia is to be considered as being formed by the petiole and the mid-rib. The development of the Liriodendron gives an example something similar to the phyllodium of Acacia. The epiphyll at first differentiates into the mid-rib, which afterwards developes from its sides the lamina, and when the lamina has begun to develope, the petiole forms rapidly. In the Acacia we have a state corresponding to the early stage of development of Liriodendron, before the lamina developes. If an arrest took place, then (the growth of mid-rib and petiole still taking place) we would have an organ corresponding exactly to the phyllodium of Acacia.

The development of the lamina always precedes that of the petiole; the lamina being always developed more or less before the petiole begins to develope. The petiole is developed between the hypophyll and base of the lamina, exactly as a part of the mid-rib between two neighbouring pairs of pinnæ. The petiole developes either, after the parts of the lamina have fully appeared, as in many compound leaves, or before the parts of the lamina begin to form, as in the Liriodendron. De Mercklin and Trécul supposed that in Liriodendron the petiole developed first, but Eichler shows this to be incorrect.*

We shall now proceed to examine briefly the further development of the epiphyll, but more particularly of the lamina part. This involves a consideration of all the different forms of leaves. We have, therefore, to consider the division of the lamina into the different parts of which it is composed in a compound leaf, or the serratures of a simple one. Eichler calls this the development of the Spreitenglieder.† By spreitenglieder he means the divisions of the lamina, whether pinnate or cleft, or only serrated. These spreitenglieder he divides according to their order of development, into different orders; thus, all those parts which are developed immediately from the mass of the epiphyll, he classes as parts of the first order. The parts of the second order are developed from those of the first, those of the third from the second, and so on. In bipinnate or tripinnate leaves, there is no difficulty in understanding what parts belong to the different orders, the lesser divisions being the later developed; but in others it is very difficult to tell, unless the development be watched. As an example of this, Eichler mentions the leaves of *Acer Pseudo-platanus*, and compares them with the Platanus, the former having been named from the resemblance of its leaves to those of the latter. But the development shows they are very different. In the Acer, all the five parts are of the first order, being developed at once from the epiphyll; while in the Platanus the terminal part and the two side parts only are of the first order, the second side parts being developed from the other two, and therefore of the second order.

* *Loc. cit.* p. 9.

† *Loc. cit.* p 10.

According to Eichler, it is a general rule that all the parts of one order are developed before the parts of the next order begin to appear. The exceptions occur among certain of the Umbelliferæ, with very much divided leaves.

There are two types of development of the epiphyll. In the first, only the edges of the epiphyll develope the lamina, or parts thereof; in the second, not only the edges, but other parts, form the lamina. To the first belong most of the simple leaves and most of the compound ones, while to the second belong the peltate leaves and the leaves of certain Umbelliferæ.

The development of the first of these types is the following:—The epiphyll appears as a cylindrical, undivided body, with a groove in it. The edges of this cylindrical body either slowly develope a long, transparent, parenchymatous projection, which enlarges regularly, and forms the lamina of simple feather-veined leaves, as Beech, Citrus, Magnolia, &c.; or they form a lamina which, instead of being regular and continuous, appears only at certain parts, as in the Reseda, Quercus, Liriodendron, &c. In the cases just mentioned only parts of the first order are developed. In other plants, numerous small mammillæ appear on the sides of the cylindrical projection, from which leaflets are developed, as in Robinia, Astragalus, &c.; or these leaflets may be still further divided, as in Achillea, Anthemis, &c. In all the above cases the cylindrical body is the mid-rib, and hence the development of the mid-rib is the primary process, the development of the spreitenglieder secondary.

The reverse of the above also takes place, in which we have the development of the spreitenglieder the primary process, and that of the mid-rib the secondary. This occurs in most ternate, pinnate, digitate, and palmate leaves. Here the leaflets are developed not at once from the midrib, as in the Robinia or Astragalus, but from above downwards, one after the other, basipetally, or from the base upwards, basifugally, a pair of leaflets being developed at a time, and then the mid-rib following.

From this we learn, that under the ordinarily received name of pinnate leaves, are grouped together a series which develope in no fewer than three different ways—either, first, as in the Robinia, the leaflets appearing from the primarily-

developed mid-rib; or, second, the leaflets appearing in pairs basipetally, as in the rose, the mid-rib developing after the first pinnæ; and, third, basifugally, as in the pea, &c.

Of the second type there are two varieties. In the first, the edges, and also the lower part of the epiphyll, develope leaflets, as in the Lupin, Oxalis, Geranium, Tropæolum, and in peltate leaves, &c.; in the second, parallel rows of leaflets appear on the inner side of the epiphyll, as in the leaves of some Umbelliferæ.

We shall now proceed to consider the types of development of the forms of leaves, or the further development of epiphyll. The first attempt to divide leaves according to the development was made by Steinheil,* who distinguished between what he called the centripetal and centrifugal modes. In the centrifugal type the base of the leaf was developed first, and he believed this was the type on which all compound leaves were developed. The centripetal was the reverse of the centrifugal, or the apex developed first and the base last; and to this type he referred all simple leaves. Schleiden † and De Mercklin,‡ and more recently Schacht,§ held that there was only one type, the centripetal of Steinheil, and that the apex was always developed first, the base last. Naegeli, on the other hand, held that all leaves developed after the centrifugal type, thus giving an opinion directly at variance to that of Schleiden. Trécul distinguished four types. These are—1*st*, the basipetal; 2*d*, the basifugal; 3*d*, the parallel; and 4*th*, the mixed. In the first, or basipetal type, the parts develope from the apex towards the base, so that the younger are nearer the axis; in the second, or basifugal type, the reverse takes place—the older being towards the axis, the younger away from it; in the third, or parallel type, the parts develope simultaneously between apex and base, and are therefore of the same age; and lastly, the fourth, mixed type, comprises all that cannot be included in the other three types. Trécul characterises the type as chiefly having

* Steinheil. "Observations sur la mode de l'accroissement des feuilles," in Annales des Sciences Nat. (2 ser.) tom. viii.

† Grundzüge der Wissenschftl. Botanik, II. Auft. Bd. ii., p. 171, *seq.*

‡ Zur Enwickelungsgeschichte der Blattgestalten. Jena 1846.

§ Grundriss der Anatomie und Physiologie der Gewächse, p. 109.

the centre parts oldest, and those towards apex and base youngest. Trécul's classification is not comprehensive enough, because he has confined himself to the development of parts of the first order only. Now the parts of different orders develope quite unconnected with those of next and lower orders;—we must therefore always take into account the development of parts of the first order as affording characters of the different types, and under each of the types consider also as subdivisions the development of the parts of the second or higher orders.

Eichler gives eight types. One of these occurs only in a secondary way, so we cannot consider it as a type. We shall therefore consider seven types, with different varieties under each. To these types belong both simple and compound leaves. The distinction is one not in type of development, but merely in the degree to which the differentiation of parts has been carried. The difference is thus only one of *degree of division*, not of type. The same view is stated in the abstract of a paper read at the Linnean Society on Nov. 2, 1865, by Harland Coultas, Esq., in the "Gardener's Chronicle," Nov. 25. The general view is correct, but the difference of type has not been kept in view, as he says (*loc. cit.*)—"The passage from the digitate to the pinnate form is simply affected by the genesis of an axis or common support of the leaflets, which thus become separated and distributed on either side of that axis. The formation of the axis is considered as the result of the superior vital activity of the leaflets of the pinnate leaf; whilst in the digitate leaf that axis is rudimentary, simply because the leaflets are deficient in the vital power necessary to form one." It is simple enough when so put, but the comparison cannot be entertained for a moment on account of the difference of type of development. We have already shown *pinnate* leaves develope in different ways, but the *digitate* leaf, as in the horse chestnut, developes after the ternate type, and in fact affords no ground for comparison.

As before pointed out, either the edge alone, or edge and inner surface of the epiphyll developes the blattglieder. This enables us to divide the whole series of leaves into two divisions, under which we can arrange the different types. *First*, Those in which the edge of the epiphyll alone

developes the blattglieder. This includes five types; Eichler, however, gives six: 1, Basifugal, and 2, Basipetal types (Eichler in Trécul's sense). 3. The Divergent type (Eichler), in which the blattglieder develope from the central part towards both ends, as in Trécul's mixed type. Eichler gives a convergent type, the converse of this, but it occurs only in parts of the second order, and is therefore not a *type*. 4. Simultaneous (Eichler), where the parts develope simultaneously between base and apex. 5. Ternate (Eichler), in which two opposite parts are developed from one of higher order, occurring very frequently, but was confounded with the basifugal type by De Mercklin and Trécul. *Second*, Those in which the inner side as well as the edges of the epiphyll develope blattglieder. This includes two types. 6. The Cyclical type (Eichler), which is found in peltate and such leaves;—the parts, however, may be developed basifugally, basipetally, &c. 7. The Parallel type (Eichler, *not* Trécul), with the blattglieder, developed in vertical rows on both sides of the middle line, and *parallel* to the marginal rows.

Eichler gives lists of the plants whose leaves develope in different ways under the different types. I shall only give a few examples, and refer to Eichler's paper for further information:—

A. Blattglieder, developed only from the edges of the epiphyll.

Type I. Basifugal.*

Parts of second order (if present) basifugal.

Pisum sativum (α), *Mahonia fascicularis* (β), *Staphylæa pinnata* (γ), *Ruta graveolens* (α). All Leguminosæ, with true pinnate leaves (γ), several Umbelliferæ (γ).

Type II. Basipetal.

(α) Parts of second order (if present), basipetal.

Myriophyllum (α), Rose (α), Potentilla (α), Poterium (α). *Helleborus fœtidus* (γ). Most Monocotyledons, except Palms (γ).

(β). Parts of second order, basifugal.

Acer Pseudo-Platanus (α), *A. platanoides,* and the other species of Acer (γ).

* The *type* is only applied to parts of the *first order*. (α), Examined by myself. (β), On Trécul's authority. (γ), On Eichler's authority.

Type III. Divergent.

Parts of second order (if present), basifugal, but divergent in relation to parts of the first order.

Achillea (α), Pyrethrum (γ), Anthemis (γ), &c.

Type IV. Simultaneous.

Parts of second order (if present), simultaneous.

Raphis (α), Palms (γ).

Type V. Ternate.

(α), Parts of second order (if present), ternate.

Trifolium (α), Cytisus (α), Fragaria (α), Aquilegia (α), Pæonia (α), *Isopyrum thalictroides* (γ), *Thalictrum aquilegifolium* (γ).

(β), Parts of second order, ternate; but in parts of higher orders only the middle part (or also one of the side parts) ternate.

Aralia spinosa (β), *A. japonica* (γ), *Thalictrum flavum*, *T. vaginatum*, &c. (γ).

(γ), Parts of the second order produced as bifurcations of the side parts of the ternation of the first order.

Liquidamber styraciflua (α), Platanus (α), *Æsculus Hippocastanum* (α), *Ranunculus hederaceus*, &c. (γ). *Aconitum Napellus* (α), *Helleborus niger* (γ), *Anemone sylvestris* (γ), &c.

B. Blattglieder, developed from the inner side, as well as edges of the epiphyll.

Type VI. Cyclical.

(α), With basipetal development.

Ricinus communis (γ), Tropæolum (α), Geranium (α), Lupinus (α), and apparently all peltate leaves (γ).

(β), With simultaneous development.

Podophyllum peltatum (α).

(γ), With divergent development.

Drosera rotundifolia (α), *D. intermedia* (γ), &c. (The glands develope in a convergent manner towards the centre from both ends.)

Type VII. Parallel.

(α), With basifugal development.

Fœniculum (α), Libanotis (γ), *Ferula Ferulago* (γ), and other Umbelliferæ (γ).

(β), With basipetal-cyclical development in the parts of the first order.

Spiræa lobata (Trécul).

3. *Development of the Hypophyll.*

The stipules are developed from the hypophyll—either the edges alone, or the part between the axis and epiphyll, taking part in the development. When the edges of the hypophyll develope the stipules, then we have free lateral stipules produced. If the part between the axis and epiphyll take part in the development, then we have such stipules as the ochrea produced. The stipules may either appear very early, before the parts of the epiphyll begin to develope, or they may appear after they are developed, or during the evolution of the blattglieder. One plant, however, always follows a certain mode, and does not vary from it. The free lateral stipules are to be considered as typical, and the other varieties are but modifications.

If modified by adhesion, we have adnate stipules. They may adhere to each other, as in the single interpetiolar stipules of Cinchonaceæ. In Galium the stipules are not united throughout their whole length, but only at the base, and assume a leaf-like appearance. They have no buds in their axils, and develope from the hypophyll, and not from the epiphyll. In *Ricinus communis* the phylloblast appears as a ring round the axis, the stipules being united at the part opposite the leaf-stalk. The stipule is thus placed opposite the leaf, and not beside it.

Adnate stipules are generally considered to be those united to the petiole, as in the rose. Eichler denies this, and says that the broad part in a rose-leaf bearing the stipules is the developed hypophyll, the petiole only beginning where the stipules terminate. I do not think we have as yet sufficient grounds for this view, and prefer to consider the stipules of the rose as adhering to the petiole, as I have not been able to trace, by development, that the part alleged is really the hypophyll. We shall therefore consider adnate stipules as those which adhere, either together, as Eichler defines them, or adhere to the petiole.

We must be careful to distinguish between sheathing petioles and sheathing stipules. In the Fœniculum, Ægopodium, Thalictrum, &c., we have sheathing petioles, the development clearly showing that they are developed by the epiphyll alone. In Helleborus, &c., the hypophyll developes

no stipules or appendages, the petiole alone enlarging and forming a true petiolar sheath. In many Umbelliferæ there are sheathing stipules, in which not only the edges, but also that part of the hypophyll between the petiole and axis take part in the development. We may have three forms—First, the ochreate stipule, in which we have adhesion of the two stipules, so as to form a single stipule, situated in the axil and around the leaf, as in Polygonaceæ, &c. In the second form we have the stipules united at both edges, forming the peculiar stipule seen in the India-rubber; while in the third we have no adhesion of the two, or what would be a stipule of India-rubber cut into two, an example of which we see in the *Liriodendron tulipifera.*

There are certain minute organs called stipels produced at the base of the leaflets in Thalictrum, Phaseolus, &c. They appear to be secondary stipules, but little is known about them. They differ considerably in many plants, and are chiefly seen in those whose leaves develope after the ternate type, where each sub-division is a repetition of the other.

In this communication I have attempted to verify a few of the leading facts mentioned by Eichler. For this purpose I selected types of the more important plants, and carefully watched the development. The results are given, for the most part, from what has been observed; and, at the same time, the chief views of Eichler will be brought under the notice of British botanists. The subject is one of great importance, in regard to the study of the morphology and physiology of the leaf itself, and it is also of value to the taxonomist in giving clearer views of the multitude of leaf forms, and in placing the characters derived from them on a more scientific basis. Moreover the development of the parts of the flower must also in a great measure rest on the proper interpretation of leaf development. We must, without doubt, look for the solution of many of the most difficult problems in the morphology of the flower to the careful study of the development of the leaf.

The subject is a large one, and, having closely followed Eichler, the study of the dicotyledonous leaves only has been specially attempted. I have, however, also examined several Monocotyledons, as well as some ferns and lycopods. The

chief object has been to attempt to reduce all the leaf-forms to a few well-marked types, and thus introduce a natural classification of leaves, instead of the artificial one generally adopted. In this Eichler has succeeded admirably, and I trust that his observations will enable a natural classification of leaf-forms to be given, and also that our views of leaf morphology will be placed on a sure and strictly scientific basis.

V. *Report on the Flowering of Plants in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Since the last meeting of the Society (11th January 1866) vegetation has progressed at a very rapid rate, owing to the comparative mildness of the weather. On the 12th of January the thermometer, about daylight, fell to 20°, and on the 13th to 21°. With the exception of the 29th, 30th, and 31st of January, when the thermometer on each of these mornings fell respectively to 31°, 30°, and 28°, no other mornings showed any appearance of frost. Since the commencement of February the lowest point indicated up to yesterday was 36°; while this morning (9th February) the thermometer fell to 30°, but only for a short period. The report on the aspect of the open-air vegetation laid before the last meeting, showed that fifty-one species of plants were then in flower. This large number has greatly diminished the amount usually recorded as being in bloom at February meeting—only ten extra being now added—viz., *Galanthus nivalis* on the 14th January; *Eranthis hyemalis* on the 20th; *Crocus vernus*, 22d; *Leucojum vernum*, 24th; *Scilla bifolia*, 30th; *Galanthus plicatus* on the 4th February; *Orobus vernus*, 6th; *Nordmannia cordifolia*, 7th; *Scilla sibirica*, 8th; *Symplocarpus fœtidus*, 8th. Many of the plants recorded as being in flower on the 11th of January had only a few blooms expanded at that time; some of these are now in perfect beauty, such as *Helleborus purpurascens*, *H. Abschasicus*, *H. albicans*, *H. olympicus*, *Crocus susianus*, &c. Many of the ordinary herbaceous plants continue to flower profusely, and have been blooming during the whole winter. Of these may be mentioned the pansy,

sweet violets, primroses, oxlips, the gentian, stocks, wall-flowers, and the sweet-scented and white coltsfoot. The winter aconite, the common and Crimean snow-drop, and vernal snowflake are now in perfection, and all the varieties of the *Crocus vernus* are rapidly advancing. Calceolarias and verbenas are still alive in the open borders, no frost yet experienced being sufficient to destroy them. Herbaceous vegetation of every description is advancing fast, such as tulips, crown imperials, narcissus, jonquils, snowflakes, and gladioli, some of them having pushed from two to six inches through the ground. Many of the flowering shrubs and trees continue to progress freely ; the yellow Japan jasmine is still in full bloom, and the *Rhododendron nobleanum* is also in flower in sheltered situations ; while the *R. atrovirens*, from the incessant gales accompanied by heavy showers, has been robbed of the beauty which it usually presents at this season of the year. *Salix violacea* and *Cydonia japonica* are also in flower, standard plants of the latter being unusually green with new-formed foliage, and also thickly studded with flower buds. The *Garrya elliptica*, hazels and poplars are still covered with their catkins. The buds of lilacs, roses, scarlet currants, Canadian mespilus and thorns are now far advanced, the leaves of the latter being partially expanded, as shown by specimens exhibited to the meeting. The leafbuds of all the deciduous forest trees are thickening up very fast, so as to make them appear darker and heavier than they generally do at this period of the year. There is every prospect of an early spring, unless some unforeseen change of weather takes place. Many of the plants now recorded as being in flower are fully a month earlier compared with late years.

From a record kept by Mr M'Nab of the flowering of the snowdrop during the last sixteen years, marking the date of the opening of the first bloom during each season, it appears that in 1863 the first flower was seen open towards the end of December. In 1851, 1852, 1853, 1854, 1858, 1859, 1860, 1861, 1862, 1864, 1865, and 1866, the first flowers were observed open in January, and mostly between the 8th and 24th of that month. In 1850, 1856, and 1857 they opened in February, while in 1855 it was the month of March be-

before the first bloom appeared, owing to the frozen state of the ground under a coating of snow.

The Rev. Francis Redford sent a notice of the flowering of *Daphne Mezereum* on the 21st January, the winter aconite on the 24th, and the *Crocus susianus* on the 26th, at St Paul's Parsonage, Silloth.

8th March 1866.—Dr Alexander Dickson, V.P., in the Chair.

The following Donations to the Library were laid on the table:—

Transactions of the Royal Scottish Society of Arts, Vol. VII. part I.—From the Society.

Lychnophora Martius und einige Benachbarte Gattungen, von C. H. Schultz-Bipontinus.—From the Author.

Jahresbericht der Pollichia eines Naturwisschaftlichen Vereins der Rheinpfalz.—From the Society.

Sur la Possibilité d'atteindre le Pole Nord, par M. Charles Martins.—From the Author.

The following Donations to the University Herbarium at the Royal Botanic Garden were announced:—

From Dr John Kirk.—Collection of plants from Renkioi, Syria, Olympus, Dardanelles, Egypt, &c.

A letter was read from M. Areschoug, Professor of Botany, Upsala, thanking the Society for his election as a Foreign Member.

The following Communications were read:—

I. *Notice of the Plantations of Cinchona at Darjeeling.* By Dr Thomas Anderson, Calcutta. Communicated by Professor Balfour.

Dr Anderson states that plantations of Cinchona have been formed at Darjeeling at five elevations—viz., 5321 feet,

5000 feet, 4410 feet, 3332 feet, and 2256 feet above the level of the sea; and that the number of Cinchona plants in these plantations on 1st November 1865, were—*Cinchona succirubra*, 43,134; *C. Calisaya*, 142; *C. micrantha*, 4264; *C. officinalis* (including vars), 56,330; *C. pahudiana*, 5092—total, 108,962.

II. *Notes of a Botanical Tour through the United States in* 1865. By Mr R. M. Stark.

The author gave a short sketch of various botanical trips he had made during last year in the United States, and noticed the principal plants which he had met with. His first field of investigation was New York and its vicinity, where he gathered many interesting species, such as *Hibiscus moscheutos*, *Vernonia noveboracensis*, *Cheilanthes vestita*, and *Woodsia obtusa*. Proceeding to Philadelphia, he visited the pine barrens of New Jersey, which produce a vegetation peculiar to the district, represented by *Drosera filiformis*, *Hudsonia ericoides*, *Gentiana angustifolia*, *Lycopodium carolinianum*, &c. In returning from New York to Canada, he ascended Mount Washington in New Hampshire, which is between 6000 and 7000 feet high. There many interesting alpine plants were met with, including *Andromeda hypnoides*, *Diapensia lapponica*, *Rhododendron lapponicum*, *Houstonia cærulea*, *Menziesia cærulea*. He found that these alpine regions were not so much visited by botanists as might be expected, considering that there is a comfortable hotel at the summit of the mountain, and a good carriage road all the way.

III. *Report on the Flowering of Plants in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Mr M'Nab stated that since the last meeting of the Botanical Society (9th February 1866), vegetation had almost been at a standstill, in consequence of the prevalence of frost and snow. Up to the date of last meeting, the lowest readings of the thermometer were 20° and 21°, which hap-

pened on the 12th and 13th of January. On four other mornings only did the thermometer fall below the freezing point—viz., once to 28°, twice to 30°, and once to 31°. The comparatively mild weather then experienced caused vegetation to advance rapidly, as indicated by the large number of plants in flower, recorded at the meetings of the Society on 11th January and 9th February. Since the latter date, there has been a complete change. Only on three mornings did the thermometer at daylight stand above the freezing-point—viz., on 22d February, when it indicated 34°; 23d February, 38°; and 3d March, 34°; on all other mornings the thermometer ranged from 28° to 32°, except on the morning of the 5th of March, when it fell to 14°. At the present time, snowdrops may be said to be in perfection, as well as the winter aconite, vernal snowflake, and the cloth of gold crocus *(C. susianus)*, while the ordinary varieties of spring crocuses, with the exception of the large yellow variety, are still very far behind. *Scilla sibirica* and *S. bifolia* remain much in the same state as at the last report.

Many of the plants previously mentioned as being in bloom during the months of January and February have not advanced. The dark variety of *Primula vulgaris* has been flowering freely since the beginning of December. The varieties of *Primula vulgaris* are exceedingly hardy, and therefore very useful, and ought to be more cultivated during the spring months as edging plants. When done flowering, they can be stored away in some back corner till autumn. The dwarf *Narcissus pumilus*, which usually flowers about the end of February, is not yet showing bloom. The crown imperial (*Fritillaria imperialis*), which has been noted in flower as early as the 10th of March, is not more than six inches above the surface of the ground, which is exactly the height it was on the 9th of February last. *Ribes sanguineum* has been recorded in flower as early as the 5th of March, but up to this time there are no signs of any of the flower-buds opening. The flowers and unexpanded buds of all the early rhododendrons, particularly those belonging to the *Nobleanum* set, have been totally destroyed by the late severe frost, while all the later varieties seem as yet uninjured. The catkins of the hazel and poplar have become brown and flaccid, as well as the young

growths on many of the roses produced during the winter months. The spring-flowering hellebores have suffered much, and the young shoots of many other perennial herbaceous plants are more or less injured. Intermediate stocks and wallflowers planted out last August have grown rapidly during the autumn and winter months. This advanced state has caused many of these plants to get destroyed by the recent low temperature. In some cases their tops were taken off late in autumn for the purpose of dwarfing, which has caused them to put out numerous young growths. Those so treated are now in perfect health, while many of those uncut are much destroyed. The topping of many of these plants seems to secure them against the effects of an inclement winter. Owing to the state of the weather during the past month, few plants can be added to the former lists. Of shrubby plants, the only additional one to record is *Nuttallia cerasiformis*, a rosaceous plant, which came into flower on the 12th of February, both on walls and standards. This introduction from California may be ranked amongst our earliest shrubby plants, introduced during recent years, both for flower and foliage. This is one of the few instances of the same generic name being applied to two different plants at the present time. The plant under consideration was named *Nuttallia* by Dr Torrey in 1848, after a distinguished American botanist. The other plant which has the same generic name is an American malvaceous plant, named after the same botanist, by Dick, in 1833. Amongst the herbaceous plants which have flowered since the last meeting are *Sisyrinchium grandiflorum album* on the 23d of February, *Arabis albida* on the 24th of February, and *Aubretia grandiflora* on 25th February; certainly a short list when the advanced period of the year is considered.

Mr Alex. Craig Christie recorded the following new stations for rare plants, in the neighbourhood of Edinburgh, viz.:—*Scutellaria galericulata*, in a marsh near Dunearn Hill, abundantly; *Mercurialis annua* and *Artemisia campestris*, at St Davids; and *Lastrea spinulosa*, in Humbie woods.

Miss Gibson-Craig, Hermiston House, sent a notice regarding a hyacinth bulb which had been placed in a

flower-pot in an inverted position. It produced leaves and a flowering stem with flower-buds beneath the soil, which, when the plant was taken out and placed in the proper position, expanded in a few days.

Mr W. H. Symes presented specimens of eight species of fungi, some of them being new to Britain. They were collected in 1865 by Dr E. Capron, near Guildford in Surrey.

Dr Carrington presented specimens of *Scapania Barthorgii*, Nees—a species new to Britain.

Mr Daniel Hanbury presented to the Museum fruit of *Myroxylon peruiferum* from Brazil.

Mr P. S. Robertson exhibited twigs of *Cupressus corneyana*, with male and female flowers.

Dr Balfour announced that the herbarium of the late Dr Lindley was now being offered for sale.

Dr Schœdhe Robertson presented, through Dr Nivison, a walking-stick made from the stem of the Jersey tree-cabbage.

12*th April* 1866.—Dr Greville, President, in the Chair.

The following Donations to the Library were laid on the table:—

Transactions of the Northumberland and Durham Natural History Society, Vol. I., Part 1.—From the Society.

Transactions of the Scottish Arboricultural Society, Vol. IV., Part 1.—From the Society.

Mittheilungen des Naturwissenschaftlichen Vereines für Steiermark, heft 1–3, 1864.—From the Natural History Society of Graz.

Beretning om en Botanisk Reise i Valders, foretagen i Sommeren, 1864, af H. C. Printz.—From the University of Christiania.

Zologisk-Botaniske Observationer fra Gudbrandsdalen og Dovre, af Robert Collett.—From the University of Christiania.

Scriften der Königlichen Physikalisch, Oekonomischen Gesellschaft zu Konigsberg, Parts 1 and 2, 1864.—From the Society.

The following Donations to the Herbarium were announced:—

From Dr Rae—Parcel of Plants collected in 1864, between Fort Garry and Fort Pitt, on the Saskatchewan River, between lat. 50° and 52° 30′ north, and long. 96° to 108° west.

From Dr John Lowe, Lynn, Norfolk—Rare English Plants.

From Professor Dickie, Aberdeen—Specimens of Azolla from Victoria, Western Australia.

From the Hon. Mrs Mackenzie—Specimen of *Linaria reflexa* from Mentone.

The following Donations to the Museum at the Botanic Garden were noticed:—

From John Wright, Esq., W.S.—Section of Stem of Hickory Tree grown at Inverleith Row, Edinburgh, by the late Captain Mitchell.

From Mrs Douglas, Morningside—Flour made from American Buckwheat.

From Messrs J. and J. Cunningham, West Bow—Palm-nut Meal from Africa.

From Mr John Sadler—Specimens of Dried Fungi.

From Mr Adam White—Specimen of Fasciated Stem of *Daphne Laureola*.

The Secretary laid on the table letters of thanks which he had received from the following gentlemen, for their election as Honorary and Corresponding Members:—M. A. Bunge, Dorpat; Professor Visiani, Padua; Dr Brandis, Bonn; Professor Asa Gray, Harvard University, Cambridge, Mass.; M. Planchon, Montpellier; Dr F. Welwitsch, London.

Dr Brandis sent a letter announcing the proposed sale of the vegetable microscopical preparations belonging to the collection of Dr Sanio, Privat-docent of Botany at Konigsberg. There are 2243 slides, with specimens for the microscope; and the value of the whole is L.225.

The following Communications were read:—

I. *On the Ravages of* Scolytus destructor, Cossus ligneperdus, *and other Insects, on Forest Trees.* By Professor Archer.

The extensive ravages made in the forests and plantations of Europe by various insects in their larva state have lately attracted much attention from those interested in the preservation of timber trees. Hitherto nothing has been done systematically in this country for preventing or curing the evil; but the greater value of wood in France has led our ingenious and highly methodical neighbours to investigate the matter thoroughly; and several eminent men have bestowed time and attention upon it, and have devised means for saving the trees which are attacked. Dr Eugene Robert of Bellevue, France, has been most successful. He finds that if the bark is removed *partially* from the parts attacked, the larvæ can be killed by an application of gas tar, after which a new growth of bark covers the exposed part of the stem. If left to itself, this would cause a sort of strangulated growth of the wood, because the new bark clings so tightly that the tree becomes what is technically called *hide-bound* under it. He remedies this by an instrument in the form of a triple hook, with sharp cutting point, and with this he scratches the young bark longitudinally. The effect is complete, and many trees are saved by this method, which otherwise would be quite killed.

The most serious of these insect enemies are—*Scolytus destructor*, which particularly attacks the elm. This tree is also subject to injury from *Scolytus pygmæus*, *S. multistriatus*, *Hylesinus varius*, *Saperda punctata*, *S. carcharias*, *Zeuzera æsculi* or wood leopard, and *Cossus ligniperdus* or goat moth. The oak is attacked by *Scolytus multistriatus*, *S. intricatus*, *Clytus arcuatus*, *Cerambyx heros*, &c. The ash by *Hylesinus fraxini*, *H. crenatus*, &c. The coniferæ by *Scolytus pini*, &c. The apple and plum by *Scolytus pruni.* The acacia by *Clytus mysticus*, &c. The birch by *Scolytus betulæ.* The larvæ of all these, except Cossus, are as small as grains of rice; but those of *Cossus ligniperdus* are often more than an inch in circumference, and form a favourite food for the woodpecker.

The paper was illustrated by specimens of wood, showing the effects produced by the different insects.

II. *On the Production of Alcohol and Paper from Wood.* By M. Colladon. Communicated by Professor Archer.

III. *Notice of Fungi collected near Bridge of Earn, Perthshire, in September* 1865. By Mr John Sadler.

The author gave an account of an excursion he made in September last to the woods in the neighbourhood of Bridge of Earn for the purpose of collecting fungi. He enumerated about forty species, some of which are of rare occurrence in Scotland.

The paper was illustrated by dried specimens of the plants.

IV. *List of Marine Algæ collected in Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S.E., &c.

My collection of Otago Marine Algæ was made (in 1861) chiefly in the following localities:—

1. In rock-pools, at low water, Greenisland Peninsula or Bluff (columnar basalt); about eight miles southwards of Dunedin.

2. The shores of Otago Harbour, especially about Dunedin itself; and between it and Port Chalmers, eight miles distant.

3. The coast at Ocean Beach (sand dunes), and the Forbury (Trappean rocks and cliffs), about two miles west of Dunedin.

4. The Greenisland coast between Ocean Beach and Otokia, Saddlehill; a range southward of about ten miles.

5. The coast on both sides of the mouth of the Clutha, extending for about ten miles north and south thereof, including the cliffs and coast between the Kaitangata coal-field and the Clutha sand-spit; the said sand-spit itself; Willshire's Bay; the Nuggets and Shaw's Bay (cliffs and shingly beach).

All these localities are on the *east* coast, and give a fair representation thereof; including deep and shallow water; sand, shingle, and mud beaches; and cliffs and rocks of varying height and mineralogical character.

I am indebted for the determination of the species in the following enumeration to the kindness of my friend Professor Harvey of Dublin. *Before* he examined my collection, he wrote me*—" The New Zealand sea is not a very rich one (though Otago is a much better habitat than Auckland), and I rarely find *new species* in the later parcels received." His anticipations were fully borne out, the result of his examination being that not a single species *new to science*, and only one *new to the New Zealand Flora*† were found among my collectanea. It must be borne in mind, however, that my collection was extremely limited and superficial ; and I cannot think that a systematic and full collection of even the marine algæ of the Otago coasts would be equally barren in the discovery of novelties. It is of interest—as regards the geographical distribution of the species contained in the following list—that only five species, or about 16 per cent., are British ; a striking contrast to the fresh-water *Diatomaceæ*, no less than 86 per cent. of which—that is, the great bulk thereof—are British. Moreover, of the marine algæ undernoted, the British species are confined, with one exception (*Ceramium rubrum*), to the *Chlorospermeæ*. I saw no lack in Otago of fresh-water and terrestrial algæ—the lower or more minute forms of the *Chlorospermeæ*—which, indeed, grow abundantly in the same sorts of habitats as in Britain. But the specimens I brought home were found, on examination, not to be in a fit or favourable state for determination ; an experience which also occurred to me in Iceland in 1860. Indeed, many of the fresh-water algæ decay so readily, that they can be properly examined *only on the spot* by the local botanist, who has in this department of botany alone a wide and interesting field of research before him. The little fresh-water ponds or lagoons of the sand dunes of the Greenisland coast—about the mouth of the Kaikorai—the product of rains, seemed covered in great measure with a confervoid vegetation. The stream called the Owhiro, which meanders through the Taeri plain, and which has become virtually a stagnant ditch—the result, perhaps, of the drainage of the plain and the cutting of the " bush" or forest—is also overgrown with

* Letter of September 10, 1862.

† Otago Cryptogams, *Trans. of the Society*, vol. viii. p. 283.

confervæ; as are to a greater or less degree the marshes of the Kaikorai. The damp face of the limestone cliffs behind Greenisland church, and similar damp rock-faces in ravines and caves throughout the Greenisland district, are coated and discoloured by various of the lower *Chlorospermeæ*, associated with *Hepaticæ* and Mosses. So abundantly do they clothe and discolour the rocks bounding the ravine, near the waterfall at Woodburn, Saddlehill, that the blackened rock has the local reputation of being *coal!* These algoid coatings of natural sections of the rocky strata are very annoying to the geologist, entirely transforming or obscuring, as they too frequently do, the petrological page that would otherwise be so legible and so attractive to him. It is perhaps unfortunate for the *geologist* that "outcrops" or sections of strata, in countries both new and old, should so frequently produce, as well as occur in, damp, shaded, wooded dells; but it is, on the other hand, equally fortunate for the *Cryptogamic Botanist*, who may there with confidence look for a rich harvest of terrestrial Algæ, and of Hepaticæ and Mosses.

MARINE ALGÆ.

I. MELANOSPERMEÆ.

Fam. I. FUCACEÆ.

Genus 1. Cystophora.

Species 1. C. retroflexa, *J. Ag.* Rock-pools, Greenisland Peninsula; Shaw's Bay.

2. C. Lyallii, *Harv.* *Fl. N.Z.*, plate 108. (C. platylobium, *J. Ag.* Otago Cryptogams,* p. 284.†)

Genus 2. Fucodium.

Species 3. F. chondrophyllum, *J. Ag.* (Xiphophora, *Fl. N.Z.*)

Genus 3. Hormosira.

Species 4. H. Banksii, *Ag.* Otago Cryptogams, p. 284.

Genus 4. D'Urvillea.

Species 5. D'U. utilis, *Bory.* Abundant on the Greenisland coast.

* "On New or Rare Cryptogams from Otago, New Zealand."—*Trans. Bot. Soc. of Edin.*, 1865, vol. viii. p. 280.

† Professor Harvey informs me (letter of March 2, 1866), that he now considers *C. Lyallii* and *C. platylobium* the same.

Fam. II. LAMINARIACEÆ.

Genus 5. Macrocystis.

Species 6. M. pyrifera, *Ag.* Abundant on the Greenisland coast.

Fam. III. CHORDARIÆ.

Genus 6. Mesogloia.

Species 7. M. intestinalis, *Harv.* Rock-pools, Greenisland Peninsula.

Genus 7. Chordaria.

Species 8. C. sordida, *Bory.*

II. RHODOSPERMEÆ.

Fam IV. RHODOMELACEÆ.

Genus 8. Chondria.

Species 9. C. macrocarpa, *Harv.*

Genus 9. Polyzonia.

Species 10. P. cuneifolia, *Mont.*

Genus 10. Bostrychia.

Species 11. B. arbuscula, *Harv.* Rock-pools, Greenisland Peninsula.

Genus 11. Polysiphonia.

Species 12. P. Lyallii, *Hook. fil.* and *Harv.* Rock pools, Greenisland Peninsula.

13. P. botryocarpa, *Hook. fil.* and *Harv.*

Fam. V. LAURENCIACEÆ.

Genus 12. Laurencia.

Species 14. L. virgata, *J. Ag.*

Fam. VI. SPHÆROCOCCOIDEÆ.

Genus 13. Gracilaria.

Species 15. G. coriacea, *Harv.*

Fam. VII. RHODYMENIACEÆ.

Genus 14. Plocamium.

Species 16. P. angustum, *Hook. fil.* and *Harv.*

Genus 15. Rhodymenia.

Species 17. R. epymenioides, *Harv.*

Fam. VIII. CRYPTONEMIACEÆ.

Genus 16. Gymnogongrus.

Species 18. G. furcellatus, *Ag.*

Genus 17. Callophyllis.

Species 19. C. Hombroniana, *Kütz.*

20. C. erosa, *Hook. fil.* and *Harv.*

Genus 18. Gigartina.

Species 21. G. radula, *J. Ag.* (Otago Crypt., p. 284.)

22. G. livida, *J. Ag.* Rock-pools, Greenisland Peninsula.

Genus 19. Iridæa.

Species 23. I. lusoria, *Harv.* (Otago Crypt., p. 284.)

Genus 20. Nemastoma.

Species 24. N. Daviesii, *Harv.*

Fam. IX. CERAMIACEÆ.

Genus 21. Ptilota.

Species 25. P. formosissima, *Mont.* Rock-pools, Greenisland Peninsula.

Genus 22. Ceramium.

Species 26. *C. rubrum, *Ag.* Rock-pools, Greenisland Peninsula: common along the east coast of Otago.

III. CHLOROSPERMEÆ.

Fam. X. ULVACEÆ.

Genus 23. Porphyra.

Species 27. *P. laciniata, *Ag.* Rock-pools, Greenisland Peninsula; Otago Harbour: common on east coast of Otago.

Genus 24. Enteromorpha.

Species 28. *E. compressa, *Grev.* Rock-pools, Greenisland Peninsula; Otago Harbour: common on the east coast of Otago.

29. *E. intestinalis, *Link.* Frequently or generally accompanies the preceding.

Fam. XI. SIPHONEÆ.

Genus 25. Codium.

Species 30. *C. tomentosum, *Ag.* Rock-pools, Greenisland Peninsula.

Fam. XII. CONFERVACEÆ.

Genus 26. Conferva.

Species 31. C. Darwinii, *Kütz.* Rock-pools, Greenisland Peninsula.

The Pacific waves cast on the Greenisland coast of Otago vast masses of "sea wrack" or "tangle," which rival in appearance and extent the similar heaps of the *Fucaceæ* thrown by the Atlantic rollers on our own western coasts, and which

* Indicates species which are *British*.

become, in the latter, the prey of the kelp-gatherer or farmer. In Otago such masses consist mainly of the commoner species of *D'Urvillea* and *Macrocystis*, with *Hormosira* and *Cystophora*. Of these the largest is *D'Urvillea utilis*, whose fronds attain a length of ten feet. Its stem and branches possess considerable thickness, and have great variety of outward form or aspect. Some specimens I picked were seven inches broad and one thick; and when dried, by exposure on the beach above high-water mark, were as hard as wood. Others were sub-cylindrical, about one-half to three-fourths of an inch in diameter. When varnished, after being dried, the latter specimens bear considerable resemblance to pieces of inflated, dried, and varnished intestine—large and small, of man and animals—as these are exhibited in anatomical museums! Between the flattened or broad, and the cylindrical or narrow forms, there is every gradation of dimension and shape. All sizes and sections are beautiful illustrations of cellular structure, the stem consisting of a series of loculi of varying size and form, separated by thin membranous dissepiments. They are rendered more interesting by the fact pointed out by Professor Harvey,* that "there is no other instance, I believe, of the *honeycomb* structure in the algæ." The stem of *D'Urvillea utilis* is, moreover, when dried naturally or artificially, perhaps capable of utilisation in the manufacture of certain articles for which horn has been hitherto employed. Illustrations of such applications of similar dried algæ from the Cape were shown in the Exhibition of 1862.† In order to draw attention to the possible economical applications of this and other New Zealand algæ, I have deposited illustrative suites of specimens in the following public museums:—1. Economic Botany, Kew; 2. Economic Botany, Edinburgh; 3. Industrial Museum for Scotland, Edinburgh.

Macrocystis pyrifera is, next to *D'Urvillea*, one of the hugest and commonest "tangles" of the east coast of Otago. It somewhat resembles, though on a larger scale, our common *Fucus vesiculosus*, of which it is here to a great extent the representative. Its pyriform air-cells, on specimens

* Letter of October 9, 1862.

† Chislin's Collection; Cape of Good Hope Exhibits.—*Catalogue*, p. 112.

thrown up on the beach, are frequently found coated with various zoophytes analogous to our *Flustræ* and *Sertulariæ*.

The genus *Hormosira* was formerly well designated by its name *Moniliformia*. Its species have a rosary-like character, the stem and branches consisting of a series of blackish, sub-spherical or oblong balls or vesicles, which separate from each other like beads, when the plant decays on the shore.

The species of *Cystophora* are among the commonest algæ of the Otago east coast. Their globular air-vesicles, which are about the size of a boy's marble, become detached in the course of the decay of the plant when cast ashore. When dry they are hard externally, and being very light, they run freely before the wind on the sands and sand-dunes.

At the Industrial Exhibition in Dunedin during November 1862, what is reported to have been "Carrageen" or "Irish moss" was shown from the coast near the mouth of the Tokomairiro; and in the New Zealand Exhibition of 1865,* also at Dunedin, a specimen labelled "*Chondrus crispus*, or Edible Sea-weed," from the island of Waiheke, Auckland, was also displayed. There is at present, however, no proper proof that the true "carrageen," or, indeed, any true species of *Chondrus*, occurs in New Zealand; and it is probable, until the contrary is established, that the Otago and Auckland "carrageen" is some species of *Gigartina* or *Gymnogongrus*, especially the former. Our British *Gigartina mammillosa* (J. Ag.), grows on our own shores, along with *Chondrus crispus*, and is collected and used for the same purposes, being frequently, indeed, preferred to the latter from its asserted superior gelatinosity.

V. *On a new species of Melanospora from Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S.E., &c. (Plate V. figs. 7–12.)

Fam. Xylographidei, *Nyl.*
Gen. Melanospora, *Mudd.*
Sp. Otagensis, *new sp.* (Plate V.)

The *thallus* (fig. 7) is sub-determinate, tartareous, thick (*a*), of cretaceous texture, and chalk-white colour; sub-

* Catalogue, p. 11.

farinose or sub-pulverulent; smoothish, but sub-rimose or sub-areolate. It resembles in thickness, colour, and texture the thallus of a sterile condition of *Pertusaria velata* (Turn.), with which it is associated in the only specimen which occurs in my herbarium; but it is much smoother, more continuous, less rimose, and free of the verrucosities which characterise the thallus of the *Pertusaria*.

The *apothecia* (fig. 7) to the naked eye are minute, black, and punctiform, studding the white thallus, on which they are somewhat prominent from the contrast of colour. Under the lens (fig. 8) they are found to vary in form from lirelloid (*bc*) to angulose or difform-lecidine (*a*); though, for the most part, they are short, sub-oblong, broadish, pseudo-lirellæ (*b*), generally straight, sometimes slightly wavy; pitch-black—disk and margin or exciple alike (figs. 10, 11); solitary or scattered, never confluent; simple; sub-sessile or adnate, scarcely immersed (by the base only, fig. 11, *c*). In the mature or old state, the disk (figs. 9, 10, 11) is flat or concave (fig. 11, *a*), with a distinct prominent margin (*b*), which varies in thickness; is generally entire, though sometimes slightly wavy or sinuous; and is usually more or less involute (fig. 9, *adb*) on the disk. In the young state, and in the lirelloid condition, the apothecia are marked by a central longitudinal chink, which is the line of opening up of the margins from the disk in process of maturescence (fig. 8, *c*; 9, *a b*). In general external characters these apothecia have considerable resemblance to those of *Opegrapha cerebrina* (DC.), *O. tesserata* (DC.), and *O. varia* (Pers.), as figured in the English Botany, plates 2632 and 1890.

The *spores* (fig. 12) are abundant and distinct, brown, 1-septate, about ·0006″ long and ·0003″ broad, oval-oblong, constricted or not, opposite or at the septum (*ab*), sometimes figure-8 shaped (*a*), or solæform (upper half broader and shorter than the lower, *b*).

The elements constituting the *hymenium* are, however, indistinct; no thecæ or paraphyses are visible, and the reaction with iodine is sometimes pale blue, sometimes none. The apothecia, indeed, in my solitary small specimen do not appear to be normally or fully developed; my specimen cannot be regarded as a typical or satisfactory one, and it remains, therefore, for the local botanist to determine the

characters of the thecæ and paraphyses, and how far my foregoing description applies to more normal or typical conditions of the plant.

Habitat.—On columnar basalt; Greenisland Bluff, near Dunedin, in the province of Otago, New Zealand, October 1861; associated with sterile conditions of *Pertusaria velata* (Turn.)

Family, genus, and species are alike new to the New Zealand flora.

The *spores* of *M. Otagensis* bear considerable resemblance to some forms or conditions of those of *Opegrapha subeffigurans* (Nyl. *Lich. N.Z.*, 258);* but the latter is a corticolous species, the thallus is obsolete, and the apothecia are compound and stellate-*Arthonioid.*

In regard to its *apothecia*, *M. Otagensis* resembles some forms of *Opegrapha spodopolia* (Nyl. *L. N.Z.*, 257),† which is a saxicolous species; but the apothecia of the latter are generally distinctly *Opegraphoid*, and frequently elongated and sinuous. The spores, moreover, at once distinguish the two plants, being in the *Opegrapha* colourless, fusiform, and polyseptate.‡

M. Otagensis appears to be closely allied to the British *M. cerebrina* (DC., Mudd, *Manual*, 226; *E. Bot.*, pl. 2632, fig. 1). It is distinguished, however, by its solitary, scattered apothecia; their more generally lirellæform character; the more frequently solæform aspect of the spores, which differ also in size, and which never exhibit the bluish or blackish colour described by Leighton.§

I have here adopted Mudd's genus *Melanospora* provisionally, for reasons of convenience, and because his classification and nomenclature are, for the present at least, those which are most familiar to British lichenologists. I do not, however, profess to agree with him in considering such a genus necessary or well established.‖

* "Lichenes Novæ Zelandiæ quos ibi legit anno 1861 Dr Lauder Lindsay."—"Journal of Linnean Society," *Botany*, vol. ix. p. 244. Lindsay, "Observations on new Lichens and Fungi from Otago, New Zealand."—*Trans. Royal Society of Edinburgh*, vol. xxiv. p. 415, plate xxix. fig. 18.

† Lindsay, "Obs. New Zeal. Lich. and Fungi," p. 416.

‡ Ibid. p. 416, plate xxix. fig. 20.

§ Monograph of British Graphideæ, 1854, p. 8.

‖ It must be borne in mind, that Corda had previously given the same

I am not to be understood as endorsing the opinion that *Opegrapha cerebrina* (DC.) should be referred to a separate genus; that that genus is appropriately designated *Melanospora;* that the genus, whether so-called or not, belongs to a group appropriately denominated by Nylander, *Xylographidei.* I have, at the least, great doubts as to the propriety of distributing three such plants as *Opegrapha tesserata* (DC.), *O. cerebrina* (DC.), and *O. lentiginosa* (Lyell), in three different genera, *Lithographa* (Nyl.), *Melanospora* (Mudd), and *Stictographa* (Mudd). In particular, the two latter *Opegraphæ* agree in certain characters, such as their 1-septate, coloured spores, which appear to ally them naturally in one genus; and they have been so allied or associated by Stizenberger.*

I admit there is a group of a few lichens—a heterogeneous and puzzling, though small one—whose apothecia are partly lecideiform, partly lirellæform; which thus possess the characters both of *Lecideæ* and *Graphideæ*, and which may therefore properly be classified, provisionally at least, in an intermediate family or tribe. I do not, however, admit the appropriateness of the name assigned by Nylander, *Xylographidei;* nor the correctness, especially as regards comprehensiveness, of its definition.

Lichenologists are, however, far from unanimous regarding the true character and position of such lichens as the three British *Opegraphæ* above named. Nylander (*Prodr.* 140)† classes *O. cerebrina* as a *Lecidea ;* though in the supplement to the same work (p. 195) he puts as a query the possibility of its more appropriate position beside *O. tesserata* in his genus *Lithographa.* Leighton, again, regards *O. cerebrina* as a true *Opegrapha;* while Mudd places it in his new genus *Melanospora;* and Massalongo, Stizenberger, and Krempelhuber in Massalongo's genus *Encephalographa.*‡ Under the whole circumstances, I am disposed to regard *Xylographidei*, *Melanospora*, and *M. Otagensis* as alike provisional, subject to re-nomenclature and re-arrange-

name to a genus of *Fungi* (that which is generally recognised by Fungologists as the genus *Ceratostoma* of Fries.)

* "Beitrag zur Flechtensystematik," St Gall (Switzerland) 1862, p. 153.

† "Prodromus Lichenographiæ Galliæ et Algeriæ." Bordeaux, 1857.

‡ Massalongo "Miscell. Lich.," 19. "Geneac. Lich.," 18. Krempelhuber "Die Lichenen Flora Bayerns." Munich, 1859, p. 206.

ment with the improvement and extension of our knowledge regarding the plants respectively hereinbefore referred to as species, genus, or family.

Description of Plate V. figs. 7–12.

Fig. 7. *Melanospora Otagensis*, Linds. About nat. size.
Fig. 8. Portion of thallus greatly magnified.
a. Lecideiform apothecia.
bc. Opegraphoid apothecia.
Figs. 9, 10, 11. Diagrammatic sections of apothecia, variously magnified.
a. Disk or epithecium.
b. Margin or exciple.
c. Semi-immersed base.
e. Young undeveloped papillæform apothecia.
Fig. 12. Spores. *a*. 8-shaped.
b. Solæform.

VI. *On the Movement of Sap in the Shell-bark Hickory.* By John Townley, Esq., Wisconsin, U.S. Communicated by Professor Balfour.

Mr Townley's communication had reference to the exudation of sap from the trunks of hickory trees after they had been cut down. He alluded particularly to the occurrence of this even during intense frost.

VII. *Report on the Flowering of Plants in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Mr M'Nab stated that since the last meeting of the Society (8th March 1866) the weather had been very variable, with frequent showers of hail and snow, particularly on the mornings of the 22d and 23d of March. The long continuance of cold easterly winds, with little or no sunshine, had considerably retarded vegetation. From 8th March till 12th April, the lowest point indicated by the thermometer was on 21st March, when it registered 25°; and the highest morning reading was on 28th March, when the thermometer at 6 A.M. stood at 49°. On ten mornings the thermometer fell to or below the freezing-point, 36° being the general average temperature on the other mornings.

During the past month little progress has been observed in deciduous trees, with the exception of the balsam poplar,

its yellow leaves being now conspicuous. In the spring-bulb department, a few stray snowdrops may still be seen in flower, as well as numerous late crocuses. The *Sisyrinchium grandiflorum*, both purple and white, is now in perfection, as well as *Puschkenia scilloides*, *Scilla sibirica*, *Scilla bifolia* (red and white), *Ornithogalum exscapum*, *Muscari botryoides* (the blue, white, and pale varieties); also *Narcissus pumilus*, *N. minimus*, and *Erythronium dens-canis*. Only twenty-nine plants can be enumerated as being in flower in addition to those mentioned at the three previous meetings. Many common or ordinary species could be given to swell the list, but it is better to adhere to those species and varieties selected when these observations were first commenced. The number below is what is usually given in at the April meeting of the Society. Some years as many as forty-one species have been recorded. In the list now submitted are several plants which have been frequently noticed as being in bloom at the March meeting, while many of those usually recorded at the April meeting are not yet in flower.

Scilla bifolia major,	March 12.	Corydalis cava,	April 2.
Narcissus pumilus,	„ 14.	„ tuberosa rubra,	„ 3.
Iris reticulata,	„ 14.	Muscari batryoides cæruleum	„ 3.
Omphalodes verna,	„ 14.	„ „ album,	„ 3.
Mandragora officinalis,	„ 16.	Hyoscyamus Scopolia,	„ 3.
Muscari racemosum,	„ 18.	Pulmonaria mollis,	„ 3.
Erythronium dens-canis,	„ 19.	Muscari botryoides pallidum,	„ 5.
Puschkenia scilloides,	„ 21.	Fritillaria imperialis,	„ 6.
Scilla bifolia alba,	„ 21.	Primula nivalis,	„ 7.
Narcissus minimus,	„ 26.	Narcissus moschatus,	„ 7.
Ornithogalum exscapum,	„ 28.	Ribes sanguineum (standard)	„ 9.
Ranunculus Ficaria,	„ 28.	Hyoscyamus physaloides,	„ 10.
Draba aizoides,	April 2.	Corydalis solida,	„ 10.
Hyoscyamus orientalis,	„ 2.	Gagea lutea,	„ 12.
Corydalis bulbosa,	„ 2.		

In registering the opening of the first bloom of *Ribes sanguineum*, the plant selected for this purpose is a large standard specimen growing at the west side of the garden, raised from a cutting taken from one of the original plants introduced by the late David Douglas. The following table will show the range of the time of flowering of this scarlet Ribes for the last seventeen years. During this period the flowering has been noted thirteen times during the month

of March, and four times during the month of April. The earliest period was during 1863, when the first flower observed was on the 2d of March, and the latest during 1864, on the 12th of April. Some blooms on standard seedlings raised in this country were observed open this season on 6th April, while those trained on walls were in bloom on the 2d:—

Dates of Blooming of the Ribes sanguineum *since* 1850.

1850, . .	March 11.	1859, . .	March 23.
1851, . .	„ 5.	1860, . .	„ 18.
1852, . .	„ 21.	1861, . .	„ 7.
1853, . .	April 4.	1862, . .	„ 10.
1854, . .	March 14.	1863, . .	„ 2.
1855, . .	„ 19.	1864, . .	April 12.
1856, . .	„ 26	1865, . .	„ 8.
1857, . .	„ 26.	1866, . .	„ 9.
1858, . .	„ 23.		

The crown imperial (*Fritillaria imperialis*) has during the last seventeen years shown a similar range of flowering with the *Ribes sanguineum.* Although the earliest and latest dates recorded are not exactly in the same years, still the early and late periods generally happen during one of the early and late years for the Ribes. The earliest date given for the crown imperial was in 1861, when the first flower opened on 13th March; while the latest date was in 1865, the first flower opening on 10th April. This year the first bloom was observed on 6th April.

Professor Balfour exhibited specimens of *Nephelium Longan* in flower. This tree yields a well-known Chinese fruit called Longan or Lon-yen. The tree is at present in flower in the palmhouse at the Botanic Garden. Dr Balfour also exhibited a specimen of *Thunbergia mollissima* which had flowered in the Botanic Garden. The seeds had been transmitted by Dr Cleghorn from India.

Specimens of *Hieracium prœaltum* were exhibited, collected by Dr John Kirk, near Torryburn, Fife, in 1851; also specimen of *Pyrus fennica*, collected in Arran in 1797 by Mr J. Mackay.

Mr H. A. Husband presented artificial flowers from Jamaica, made of the leaves of maize.

Mr R. M. Stark exhibited living plants of *Hepatica obtusiloba*, *Platanthera Hookeri*, *Pedicularis Canadensis*, *Smilacina stellata*, *Delphinium tricorne*, *Aspidium fragrans*, *Pteris atro-purpurea*, and *Asplenium angustifolium*, which he had brought from America last year.

Dr Andrew Inglis noticed that *Mercurialis annua* and *Campanula rapunculoides* were growing in a wild state in the gardens at Lynedoch Place, and near St Margaret's Railway Station.

Miss Gibson-Craig sent the hyacinth plant which was noticed at the last meeting of the Society as having produced its flowers under the soil in an inverted position.

Mr Sadler exhibited a specimen of *Altingia excelsa*, taken from a plant purchased by Sir Wilford Lawson, of Brayton Hall, at a public sale in London in 1806, and for which Sir Wilford is stated to have paid twenty guineas.

10th May 1866.—Dr R. K. GREVILLE, President, in the Chair.

The following Donations to the Library were laid on the table:—

Proceedings of the Academy of Natural Sciences of Philadelphia, for 1864 and 1865.—From the Academy.

Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlande und Westphalens, 1865.—From the Society.

Quatrième Herborisation de la Société Royale de Botanique de Belgique, par M. Armand Thielens.—From the Author.

Erster Jahresbericht des Naturwissenschaftlichen Vereines zu Bremen.—From the Society.

Zoologische Miscellen, von Georg Ritter von Frauenfeld.—From the Author,

Decades of British Fungi, by M. C. Cooke, London.—From the Author.

Letters were read from Mr Thwaites, of Ceylon, Herr Georg Ritter von Frauenfeld, and Dr Schnizlein, thanking the Society for their election as corresponding and foreign members.

Mr Adam White was elected an Associate of the Society, on the recommendation of the Council.

The following notice of the late Thomas L. Bridges, from a Californian paper, was read:—

The world of science has lost an invaluable coadjutor in the death of Thomas L. Bridges, who had resided with his family in California for the last twelve years, and had traversed nearly every part of the State in pursuit of his favourite sciences of Botany and Zoology. With them he was intimately and practically acquainted, and had gathered seeds and plants and animals for societies and wealthy individuals in Europe, including hundreds of specimens of our indigenous Flora and Fauna, particularly in the Mariposa mountains and those of the Coast Range. For several years previous to 1853 he had resided in Chile, where his botanical gardens, near Valparaiso, were the resort of every lover of flowers and rare plants. He had also accumulated property, but lost it all by a winter's flood which completely swept away the earnings of his life, and caused him to emigrate to California, where he continued to reside near Oakland, until his departure for Nicaragua, on a scientific exploration in the spring of 1865. It was while returning to his family from that country that he died at sea on the 9th of September last. He had in former years made weary and laborious travels and collections in the little known district of Chiriqui, in the northern part of the State of Panama, and indeed was the only white man who had visited many parts of that country, some account of which we believe is preserved in the English scientific journals before 1850. Many years ago he made explorations in the Bolivian Andes, and passed two or three years on the head waters of the Amazon and La Platte, collecting animals and plants for the celebrated conservatory and gardens of the late Earl of Derby, near Liverpool, one of the most generous friends of science that England ever produced. These explorations had made his name famous among British naturalists, and their scientific journals often mentioned his valuable labours. His claim to the discovery of the famous *Victoria regia* is well known. Bridges was a true devotee of nature. He was of a most genial temper;

his mind was cultivated by a liberal education, extensive travel, and long intercourse with men of science and letters in Europe. His conversation and modest cordial manner captivated all who had the pleasure of his acquaintance. He was a noble-hearted Englishman, without guile or malice, and left a crowd of friends in California. The art and mystery of making money was not in his composition, and he had passed through many severe ups and downs in his California life—always in hard pecuniary luck. California lost a distinguished and useful citizen when he died; and it is to be hoped that those of his countrymen, and others whom God has made the stewards of abundance and plenty, will not forget the widow and little ones whom this large-souled man left behind, and the more because he was one of those who always had a tear and a word of sympathy for those in trouble.

The following Communications were read:—

I. *Account of a Botanical Trip to Clova with Pupils, in August* 1865. By Professor BALFOUR.

Dr Balfour, along with Messrs F. Naylor, W. R. M'Nab, Gilbert Stewart, J. Kirk Duncanson, and Morrison Watson, took a botanical excursion to Glen Clova at the beginning of August last. They visited Glen Dole, Glen Fee, Glen Prosen, Canlochan, Caness, Lochnagar, and several of the high mountains in the Grampian range. During eight days they were able to make a large collection of alpine plants. Among the rarer of them were *Lychnis alpina*, *Mulgedium alpinum* (of which they saw upwards of eighty specimens in full flower), *Gentiana nivalis*, *Carex Vahlii*, and *C. vaginata*, *Oxytropis campestris*, *Saxifraga rivularis*, *Juncus castaneus*. Dr Balfour detailed the various adventures of the party, and exhibited specimens of the plants collected. Some of the plants were shown in a living state as grown in the Botanic Garden.

II. *Descriptions of New and Rare Diatoms from the Tropics and Southern Hemisphere.* By R. K. Greville, LL.D., F.R.S.E., &c. (Plate VI.)

Surirella.

Surirella superba, n. sp. Grev.—Large, elongated, front view broadly linear, with truncate ends and rounded angles; side view panduriform, cuneate and subacute at the ends; costæ delicate, reaching the median line, the intermediate spaces minutely punctate. Length ·0050" to ·0110" (figs. 1, 2).

Hab. Cuba; in a collection communicated by Professor Hamilton L. Smith, of Kenyon College, Gambier, Ohio.

This magnificent species is allied in its form to *S. Smithii*, Ralfs (*S. constricta*, Sm.); but is twice the size, and vastly more robust in every way. In the front view the alæ form parallel lines, instead of being curved, as in *S. Smithii*. In the lateral view the costæ are not conspicuous, but, on careful examination, are perceived to reach the median line, the intervening spaces being filled up with irregular series of faint puncta.

Melosira.

Melosira setosa, n. sp. Grev.—Joints somewhat longer than broad, composed of two hemispherical valves, binately conjoined, very finely punctate, the ends beset with minute bristles. Diameter of disc ·0008" to ·0012" (figs. 17–19).

Hab. Aneityum, New Hebrides; in a collection kindly communicated by the Rev. John Inglis.

A very curious little species, distinguished from all others by the bristly ends of the joints.

Odontodiscus.

Odontodiscus barbadensis, n. sp. Grev.—Disc slightly convex, with minute, hexagonal, radiating cellules, equal, except towards the margin, where they diminish in size, and a circle of numerous, short, acute spines, situated within the margin. Diameter ·0048" (fig. 16).

Hab. Barbadoes deposit; Cambridge estate; in slides, communicated by Chr. Johnson, Esq.

This is the first species of *Odontodiscus* furnished by the inexhaustible Barbadoes deposit, with which the name of my venerable friend, Mr Johnson, will be ever associated. It is a noble diatom, and, in its strikingly radiate cellulation, serves to confirm the genus. The cellules are 6–7 in ·001″, and at the margin become smaller, and resemble coarse, remote, moniliform striæ.

Biddulphia.

Biddulphia minutissima, n. sp. Grev.—Frustules very minute, linear-oblong, punctate; valves in front view broadly capitate, with the angles produced into extremely short conical horns, intermediate space convex. Average length of frustule ·0014″ (fig. 14).

Hab. Zanzibar; in slides, kindly communicated by Professor Hamilton L. Smith. In a dredging off the island of Arran.

The only species with which the present diatom can be compared is *B. tumida*, well figured by Mr Roper in the seventh volume of the "Transactions of the Microscopical Society." It is, however, very much more minute; the valves are not so decidedly globose; and the horns, instead of tapering, as in that species, are very small, short, and conical. In none of the specimens which I examined was I able to detect any spines; but it is not unlikely they may exist, and had been broken off.

Biddulphia barbadensis, n. sp. Grev.—Frustule quadrangular; valves in front view large, minutely punctate, the angles produced into short, truncate processes; connecting zone very minutely, longitudinally striate (fig. 15).

Hab. Barbadoes deposit; Cambridge estate; in slides, communicated by Chr. Johnson, Esq.

The frustule now figured is the only one which has come under my notice; and although I have not seen the lateral view of the valve, I am unwilling to omit giving it a place among the species peculiar to the Barbadoes deposit. It appears, however, to be sufficiently well characterised. The valves, as seen in the front view, are slightly convex in the middle, but not so much so as to detract from the general

quadrangular outline. They are closely punctate, the puncta becoming more minute at the base of the valve. The processes are very short and truncate, looking like horns broken across near the base, and appear to be situated as in Ehrenberg's genus *Cerataulus*, an arrangement which is not always constant, any more than the orbicular or broadly oval form of the valve; for in some varieties of *B. aurita* the latter is often so broad as to be nearly circular. The length of the frustule is ·0025″, and the breadth the same.

Achnanthes.

Achnanthes costata, n. sp. Grev.—Valves elongated-linear-oblong, elliptical at the ends, delicately costate, with exceedingly minute intermediate puncta. Length ·0025″ to ·0030″ (figs. 8–10).

Hab. Sandwich Islands; communicated by Professor Hamilton L. Smith.

Allied to *A. longipes*, the only other costate species. A smaller and much more delicate diatom, with narrower and somewhat more pointed valves; the costæ very fine—11 in ·001″—and the staurus extremely narrow.

Achnanthes pennæformis, n. sp. Grev.—Valves very narrow, linear, elongated; in front view arched or sickle-shaped at each end, the lower valve having end more sharply and abruptly curved than the other; striæ fine. Length about ·0065″ (figs. 11–13).

Hab. Sandwich Islands, along with the preceding.

An exceedingly curious and whimsical-looking diatom, almost always presenting itself in the front view, and the lower valve especially, when detached and reversed, resembling the usual symbol employed by artists to denote distant birds on the wing; and from its narrowness and great length it might well serve to represent a flying Albatros. I have never seen more than three valves *in situ*, and never observed any trace of a connecting zone. In the front view they all appear to be acuminate at the extremities, the two upper ones having a sharply produced convexity in the middle, and rarely entirely separating from each other, at least in the process of mounting. The lower valve in the lateral view is less than ·0004″ in breadth, with one end (that exhibiting the greatest curve) somewhat narrower than

the other. When seen in the front view, each end of this lower valve is strikingly like the blade of a scythe; the median line, as seen in perspective, corresponding with the back of the scythe-blade.

Monogramma.

This genus was established by Ehrenberg in the Reports of the Berlin Academy, volume for 1843, p. 136, with the following character—"Genus e familia Bacillariorum, sectione Naviculaceorum. Lorica intus pinnulis transversis insignis spatio lineari transverso medio in uno tantum latere, lævi, aperturis ventralibus tribus, dorsalibus duabus (= Stauroptera uno tantum latere crucigera, aut = Achnanthes solitaria aperturis terminalibus)."

In his great work, "Mikrogeologie," he refers to three species by name, but without assigning any characters. He gives, however, figures of *M. ventricosa*, and, in so doing, appears to have confounded two species. If we consult his first figure (Tab. I. II. fig. 9), we have the valve represented with rounded ends. In Tab. III. figs. 18, 19, we have a series of figures under the same name, marked *a*, *b*, *c*; and under *a* he gives precedence to a valve with pointed ends, evidently another species; while under *b* and *c* we have the same diatom which was represented in Tab. I. and which has been received as the true *M. ventricosa.* With regard to the other two species above mentioned, as recorded only by name, in "Mikrogeologie," no data exist for their identification.

Monogramma ventricosa, Ehr. — Valve linear-oblong, elongated, divided by two constrictions into three inflations; the central one oblong, the terminal ones shorter and broadly rounded. Striæ 20–24 in ·001″. Length ·0025″ (figs. 6–7).

Monogramma ventricosa, Ehr. Mikrog. (Index), Tab. I. II. fig. 9; Tab. III. figs. 18, 19, *b*, *c*.

Achnanthes ventricosa, Ehr. Mikrog. p. 226.—Ralfs in Pritch. Infus. p. 873.

Hab. Isles of Bourbon and Mauritius, Ehrenberg.—Asia, Africa, America, Ralfs, in Pritch. Infus. — Cuba; New Hebrides.

According to the majority of Ehrenberg's figures, and the

tenor of Mr Ralf's description, there can be no doubt that the present diatom is *M. ventricosa.* It appears to be very constant to its characters, the only variation I have observed being in some Cuban specimens in which the middle inflation of the valve is more abrupt and prominent, causing a longer space between it and the terminal inflations. It is necessary to mention that our diatom is not *Achnanthes ventricosa* of Kützing, Bacill. p. 76, Tab. 20. fig. vii., nor of his Sp. Alg. p. 54, which he regards doubtfully as *Achnanthes rhomboides*, Ehr. Rabenhorst (Fl. Europ. Alg. p. 110) keeps up *A. rhomboides*, and gives *A. ventricosa*, Kütz, as a synonym without any question at all. But he also quotes as a synonym the species of *Monogramma* now under consideration, which has not the most remote resemblance to *A. rhomboides.* In Ehrenberg's "Verbreitung und Einfluss des mikroskopischen Lebens in Süd und Nord Amerika" (p. 423, Tab. II. II. fig. 2), is a fragment of a diatom he calls *Stauroneis monogramma*, and remarks that it is allied to *Monogramma africana*, which latter, except in name, is unfortunately a myth. The figure of this fragment is too imperfect and too indefinite to be of any value.

Monogramma Smithiana, n. sp. Grev.—Valve elongated, divided by two constrictions into three oblong inflations, the terminal ones wedge-shaped, pointed. Striæ about 16 in ·001″. Length ·0035″ (figs. 3–5).

Achnanthes ventricosa, Ehr. Mikrog. Tab. I. III. figs. 18, 19, *a.*

Hab. Mauritius, Ehrenberg.—New Hebrides.

A larger species than the preceding, with fewer, and much more conspicuous moniliform striæ, and with the inflated ends of the valves prolonged into a wedge-shaped point.

It may be a question whether these diatoms do not present a sectional rather than a generic difference. In the front view the frustules are precisely those of *Achnanthes.* Possibly, however, the remarkable feature of the twice constricted valve may be regarded as forming a part of the generic character, in which case there would be at once a clear separation. Whatever Ehrenberg intended to refer to under the name of *M. trinodis*, it is evident that it exhibited the same characteristic form. I beg to dedicate this fine

diatom to my friend Professor Hamilton L. Smith of Kenyon College, Gambier, Ohio.

DESCRIPTION OF PLATE VI.

Fig. 1. *Surirella superba*, front view.
2. „ „ side view.
3. *Monogramma Smithiana*, front view.
4. „ „ lower valve.
5. „ „ upper valve.
6. „ *ventricosa*, lower valve.
7. „ „ upper valve.
8. *Achnanthes costata*, front view.
9. „ „ lower valve.
10. „ „ upper valve.
11. „ *pennæformis*, front view.
12. „ „ lower valve, side view.
13. „ „ lower valve, front view.
14. *Biddulphia minutissima.*
15. „ *Barbadensis.*
16. *Odontodiscus Barbadensis.*
17. *Melosira setosa*, frustule.
18. „ „ frustules binately arranged.
19. „ „ disc.

All the figures × 400 diameters.

III. *Notes on the Travancore Government Garden at Peermade.* By Dr CLEGHORN, Conservator of Forests, Madras.

The proposal to establish a Government Garden upon the Travancore Ghauts, for the introduction generally, into that mountainous tract, of useful and ornamental plants, as Tea, Coffee, Vanilla, &c., but more especially for the naturalisation of the Cinchona tree, originated with Mr F. N. Maltby, the late Resident, and was in every respect an admirable one.

Mr Maltby in his memorandum, dated 23d December 1861, considered that Peermade, or rather the new station called "Mary Ville," on the proposed line of road from Alleppey to Madura, and forty-seven miles distant from Kotiam, afforded suitable advantages. It is healthy, open to the sea-breeze, with an elevation of 3300 feet above the sea, and enjoys a temperate climate; the adjoining district presents a remarkable variety of soil and scenery. Between

it and the Perryar River is an undulating plateau, where forests alternate with grass lands, affording fine pasture for cattle.

Near Peermade, on the same range of mountains, appropriate sites may be found, up to an elevation of near 6000 feet, where subsidiary plantations might be formed to suit the different species of Cinchona.

The rain-fall, according to the observations of General Cullen, who kept a register for a long series of years, varies from 40 inches on the eastern Ghauts to 125 inches in the western slopes, diminishing towards Cape Comorin; while the thermometric register of Mr Maltby at Peermade, in December 1861, shows that the mercury fell to 58° Fahr. in the early morning, and rose to 74° Fahr. at 2 P.M. in the shade. Farther observations with *maximum* and *minimum* thermometers would be very valuable.

To carry out Mr Maltby's project, His Highness the Rajah of Travancore sanctioned the following sums:—1000 rupees for the garden and glass house, 300 rupees for plants and seeds from the Neilgherries, and 40 rupees monthly for gardeners and coolies, with the promise of a suitable grant for seeds and plants as required. These sums were applied to the preliminary works in 1862. In March 1863 about 500 Cinchona plants, two months old, and from one to two inches high, were brought from Ootacamund by Mr Hannay, the Superintendent of the Garden; but more than half were lost, some in transit, and others soon after arrival, from the effects of exposure to drought, damp, or cutting winds, as the glass house was not ready for their reception.

I visited Peermade in company with Mr Markham in December 1865, and remained two days. Although Mr Maltby's scheme has not been followed out in detail, it is satisfactory to record that the Travancore Sircar has well seconded the efforts of the British Government, and that the result of the Cinchona experiment is more successful here than anywhere else in Southern India, excepting on the Neilgherries. The table on next page gives the age and height of the plants at the date of our visit.

The girth of several of the largest of the *C. succirubra* was nine inches close to the ground, and their height, for their age, was generally satisfactory; some of the plants

had been broken by the violence of the wind, but were in a healthy state, throwing out strong shoots from the seat of injury. The Cinchonas planted in the shola behind the Sircar bungalow had suffered comparatively little from the wind.*

Peermade Cinchona Nursery, December 1865.

Names of Plants.	No.	Height.	Age.	Height of tallest tree.
Cinchona succirubra,	79	5 feet ...	2 years 10 months	8 ft. 6 in.
micrantha,	45	3 ft. 6 in.	,, ,,	6 feet.
peruviana,	27	3 feet ...	,, ,,	6 feet.
nitida,	7	2 ft. 6 in.	,, ,,	3 feet.
officinalis,	60	2 ft. 6 in.	,, ,,	4 ft. 7 in.
Unknown,	6	... ...	,, ,,	3 ft. 6 in.
	225			

About 200 were also raised from layers and cuttings.

The species that thrive best are *C. succirubra* and *C. micrantha*, but *C. Calisaya* should be tried. The *C. condamenia* (or *officinalis*) is evidently planted at too low an elevation, being weak and delicate, with a tendency to throw out branches along the ground.

The Peermade garden has a southern exposure, and receives the full burst of the south-west monsoon, from the violence of which all the plants above the size of dwarf shrubs have suffered in some degree; but as the Government have in view the dissemination of seeds and seedlings rather than the formation of a large plantation, it does not seem advisable to change the site, particularly as a glass house and superintendent's cottage have been already built; the present nursery, however, might be sheltered by planting screens of Australian Acacias,† or other quick

* It should be remembered that though shelter is highly advantageous, the plants should not be overshadowed or exposed to the drip of other trees.—(*See* Mr M'Ivor's Reports.)

† *Acacia lophantha*, a fast grower, and not affected by drought, is most useful for protecting plantations. Seeds of this species, and of *A. melanoxylon* and *mollissima* have been despatched to Mr Hannay.

The *Cassia florida*, which flourishes so well at Bangalore, is hardy, and a fast grower. It should also be tried, as a thick interlaced screen might quickly be formed; directions will be given for the transmission of seed.

growing trees, and the garden might be extended in the shola behind, which is sheltered from the prevailing winds.

The experiment of Cinchona introduction having been thus far successful, it is now desirable that the Travancore Sircar should furnish the means of extended culture to the planters of this rising settlement, and to the neighbouring ranges of hills, as opportunities may arise; I, therefore, beg to suggest that twelve grown plants of *C. succirubra* be at once given to each of the planters, who are ready and desirous of commencing Cinchona culture; and thereafter, as many young plants of this, and other species as may be available, to applicants at the old Neilgherry rate, viz., four annas per single plant.

I would also suggest that a certain number, say 200 of each of the following species, *Cinchona succirubra*, *Cinchona Calisaya*, *Cinchona micrantha*, should be carefully planted in the shola behind "Mary Ville," or other sheltered slope, and a careful record of their growth be registered.

Tea.—The Neilgherry seed received in 1861 germinated freely, and there are now about seventy well-formed bushes, from two to four feet high, in flower and fruit; 400 seedlings are available, and a large seed-bed has been prepared; and when the garden stock is sufficient, the seeds and seedlings should be distributed gratuitously, or sold at a moderate rate, such as would afford a fair profit to intending speculators, who would establish nurseries on their own account; the primary object being to disseminate selected seeds from the best grown varieties, to all desirous of cultivating tea. The Neilgherry rates of one rupee per pound of seed, and 10 rupees per 1000 seedlings, might be adopted.

With regard to the quality of Travancore tea, nothing definite can be said until the leaf has been subjected to skilful manipulation; but it may be mentioned that Mr Liddell, of Binny & Co., has shown me reports from professional brokers of London and Calcutta, valuing tea, grown at Charlie's Hope, in the Ariangole Pass (elevation 1200 feet), at four shillings per pound.

It appears to be highly probable that this part of Travancore is well suited for tea culture, and therefore at least four acres of the Government garden should be planted with tea, to furnish seed of the best quality, as much disappoint-

ment has been experienced by Mr Hannay and several of the planters in attempting to raise seed imported from Assam and the North-West Provinces, the vitality of which had been lost in transit.

Coffee Nurseries have been prepared on all the estates, so that unless it be for the convenience of planters, or for the self-maintenance of the garden, the coffee shrub need not be propagated.

Vanilla.—It seems doubtful whether this plant will thrive at Peermade; it has been grown, but has not flowered. Further experiments in sheltered sites are required, as the commercial value of the pod is great, with an increasing trade in Ceylon.

The Tallow Tree of China and Mauritius (*Stillingia sebifera*), which is cultivated in China and in the northern Provinces of India along with tea, might also be tried, for which purpose a few fresh seeds have been sent to Mr Hannay. The varnish tree of China (*Elæococcus vernicifera*) might also be tried.

Vegetables.—Potatoes, onions, and other kitchen vegetables, and rhubarb, might be grown to any extent for the supply of Quilon, Alleppy, Cochin, and Trevandrum. Potatoes are sold at Ootacamund at 1½ rupee per maund, but are not delivered at Trevandrum for less than 3 rupees, and the supply is irregular.

Fruits.—Apples, pears, and grapes have been tried, but do not thrive on the crest of the Ghauts. In some of the valleys oranges would do well; raspberries and strawberries were in fruit at the time of my visit. The Mangosteen has ripened at Courtallum, and might succeed here in a well selected site.

Summary.—To recapitulate, it seems desirable that attention should be specially given to the careful cultivation of Cinchona and Tea; extensive seed-beds should be formed, and ten acres of the former and four of the latter might be planted out. This would probably be sufficient to keep the Cinchona nurseries amply supplied, and to furnish fresh tea seeds and seedlings for a fair extent of cultivation. Vanilla, potatoes, and other products mentioned, should receive due care from the superintendent. Cotton does not appear to thrive, and might be excluded for the present.

Superintendent.—Having been requested to suggest the means best calculated to increase the utility of the garden, I have no hesitation in recommending that a skilled Superintendent be procured from one of the best gardens in Europe, on a salary of (say) 150 rupees a-month, with a residence. The object in view is to improve the culture of indigenous productions, at the same time to naturalise Cinchona, Tea, and other useful exotics, and to prepare both for distribution to the other settlements in these beautiful hills and plains. For this, horticultural skill and ability are essential requirements; meanwhile Mr Hannay (whose services might be transferred to another department) should, with a trained native gardener, propagate Cinchona and Tea to the best of his ability.

The following are the principal Trees found in the Sholas adjoining Peermade, observed during a hasty excursion.

No.	English Names.	Native Names.	Botanical Names.
1	... ...	Palmaram	*Bassia elliptica* (Dalzell) or *Isonandra acuminata.*
2	Iron Wood......	Nauga	*Mesua ferrea.*
3	Anjelie	Angill, ayence	*Artocarpus hirsuta.*
4	Sack Tree	Araya, anjelly	*Antiaris saccidora.*
5	Gamboge	Mukki	*Garcinia pictoria.*
6	... ...	... ...	*Kydii.*
7	Rose Apple......	... ...	*Jambosa Munronii.*
8	Indian Plum ...	Narvelli.........	*Syzygium.*
9	Wild Cinnamon	Darchini.........	*Cinnamomum iners.*
10	... ...	... ...	*Litsoa Zeylanica.*
11	... ...	... ...	*Machilus macrantha.*
12	Black Dammer	Congiliam maram	*Canarium strictum.*
13	... ...	Vellay naga ...	*Conocarpus latifolius* (known as Dinduça in Mysore).
14	... ...	... ...	*Elæocarpus serratus.*
15	Blackwood	Eti maram	*Dalbergia latifolia.*
16	Ben-teak	Ben-teak	*Lagerstrœmia microcarpa.*

Nos. 2, 3, 11, 13, 14, 15, and 16 yield excellent timber. Blackwood is found sparingly in the western, but abundantly on the eastern slopes.

Among the shrubs and herbaceous plants which especially attracted notice were the following:—

Melastoma, *Torenia cordifolia* (Sispara creeper)—*Osbeckia*, *Cæsalpinia* (two species)—*Urena*, *Crotalaria* (two kinds)—*Solanum giganteum*, *Exacum bicolor* (Chiretta)—*Erigeron* (Coffee weed)—*Ophelia* (Vary) do—*Blumea*, *Andrographis paniculata* (Creyat)—*Smithia*, *Impatiens* (several species); and of the Scitamineous tribe, there are wild Cardamom, Ginger, Zedoary—and *Hedychium* and *Phrynium dichotomum*.

IV. *On the Treatment of Hyacinths and other Bulbous Plants during Summer.* By Mr Richard Adie, Liverpool. Communicated by Mr M'Nab.

The author showed that by lifting the bulbs of Hyacinths and Narcissuses from the soil about midsummer, and placing them for six weeks amongst sand subjected to a temperature of nearly 80° Fahr., and then laying them on a dry wooden floor till time for planting, their flowering was much stronger and freer than it otherwise would be.

V. *Notice of the Esparto Grass of Spain* (Macrochloa tenacissima). By Charles Lawson, Esq., of Borthwickhall.

In this paper Mr Lawson gave an account of the grass as seen by him in the neighbourhood of Grenada, Almeria, and Murcia in Spain. He ascertained that upwards of 60,000 tons of the plant *(Macrochloa tenacissima)* were exported last year from the east coast of Spain, chiefly Almeria and Carthagena, to Britain, the price being £4 per ton free on board. Mr Lawson suggested that it might be advisable to try the cultivation of the plant in this country, and with that view he sent fresh specimens to the Botanic Garden.

VI. *Notice of some Rhizomorphous Fungi.* By Mr John Sadler.

The author exhibited specimens of several *Rhizomorphous fungi*, collected in different situations, and described their general appearance and structure. No. 1 was recently presented to the Museum at the Royal Botanic Garden by Mr

Finlay Dun, as "roots of rushes taken from a large stone drain." No. 2 was sent by Mr James Scrymgeour as a "vegetable substance found in the interior of a coffin in the old burying-ground, Dundee." No. 3 was taken from between the bark and the wood of a decaying tree near Coventry, and presented to the University Herbarium by Mr Thomas Kirk. On microscopical examination, the author found the different specimens to be of true fungal origin, and much resembling each other in their entirely cellular structure. Nos. 2 and 3 seemed to be the same plant, while No. 1, from its looser arrangement of structure, its greater tenacity (a single rootlet being capable of lifting 28 lb.), its more extensive growth, being several yards in length, and from its anastomosing at very long distances, seemed to indicate the peculiar development of some other fungus. It is generally believed that these *Rhizomorphous fungi* are merely the mycelia of some of the common species of polyporus or allied genera, although it has not yet been satisfactorily proved that a polyporus developes a rhizomorpha, or *vice versa.* Endlicher, in his "Genera Plantarum," describes the genus, and gives good characters for it. Dr Greville describes three species in his "Flora Edinensis;" but the latter author is now of the opinion that he, along with other writers, mistook the swollen growing points of the plant for the fructification. As these plants have never been met with bearing any organs of fructification, they are entirely omitted from all recent works on fungology. They are certainly very abnormal forms, *perhaps*, of some of the commoner species of fungi; but unless certain names are retained to distinguish them until their origin has been fully traced, they will ever perplex and puzzle the student. Their situation of growth is always peculiar, and some of them are said to be very phosphorescent. Professor Balfour, in his "Outlines of Botany," remarks that these plants vegetate in the dark caverns and coal mines of Germany. They are seen hanging from the roof in great numbers, and their luminous qualities are most developed in the furthest recesses. The author concluded by reading extracts from letters he had received from the Rev. Mr Berkeley, and Mr M. C. Cooke, of the India Museum, London, to whom he had transmitted specimens for examination.

VII. *On the Effects produced on the Operator by the Poisoning of Plants in a Herbarium.* By Captain F. M. Norman, R.N., Madeira, in a Letter to Professor Balfour.

Madeira, 18*th April* 1866.

Sir,—I have for some years been living in this island, and have during a great part of that time occupied myself in forming a herbarium of the indigenous and naturalised plants of the island, which after much labour I have nearly completed, having at present about 600 specimens. The unfortunate incident which for the present has suspended my occupation, induces me to communicate with you, as a botanist of eminence and repute, to ask your advice under the circumstances. Being a perfect stranger to you, I perceive that an apology is due from me for thus troubling you. I trust, however, that the common bond of fellow-workmanship in Flora's domains (however humble a place I may occupy), will be kindly accepted by you as a sufficient one.

I have been accustomed, in order to guard the plants against the attacks of insects, to use a strong solution of corrosive sublimate (the same as that which is recommended in "Balfour's Botanist's Companion"). I used to lay it on with a feather, and, when perfectly dry, the plant thus treated was, in common with all the others, placed in a double sheet of white paper in its proper position on the shelves of a wardrobe. Perhaps, out of the whole of my 600 plants, 100 *at most* have been thus treated. The sublimate was kept in the "plant room," and never taken out of it. In the beginning of March I was taken ill, symptoms of mercurial salivation came on, and I was severely salivated. Fortunately I was in robust health at the time, and recovered quickly; my teeth, however, formerly a beautiful set, between the effects of salivation and mineral acid gargles, are entirely ruined. A fortnight after I had recovered, and was strong, I resolved to begin work again, (meanwhile, all the poison had been buried, for of course I shall use it no more). I bound up mouth and nose with a handkerchief, put on gloves, went to my wardrobe, took out a few bundles of plants, turned over a few to compare, insert new ones, &c., and put them away. This wardrobe is in my dressing-room, where I keep the dried plants, because it is

my driest room; but I never apply the poison here. I then went out of doors, had myself brushed and washed. Twenty-four hours afterwards the symptoms came on again, and I was again salivated (though in a very minor degree). Observe, that all that I did was to look at a few plants in the wardrobe, where about 10 per cent. of the plants have been treated with poison.

Now, sir, is not this an unfortunate matter? Just at the time when I am finishing the collection, when I want constantly to compare, and when, in order to complete a revised catalogue, I want to look at every single plant in detail, I find myself thus cut off from communication with my source of interest and daily occupation. Will you be so good as to write to tell me if you have had any experience in this matter; if you have used this poison to your own plants; if you know of any accidents of the same sort, and whether the collections in England are treated with the sublimate; and if they are, whether it is considered dangerous to take the plants down to examine them when required. I suppose I must be peculiarly sensitive. I am thinking of having a mask made with a glass front, and kid gauntlets, for I cannot give up, without another trial, the results of three years' hard work. If I can finish the collection, I think that it will be a complete and valuable one. I shall be much obliged if you can offer me any advice on the subject; in return, I can offer to get you any Madeira plants that you may want, which I shall have much pleasure in doing.—Believe me, Sir, your faithful servant,

Francis M. Norman.

P.S.—As regards the quantity of poison used, I have used altogether, during two years and a half, three bottles, each containing—alcohol 1 ounce, corrosive sublimate 20 grains, camphor 30 grains; and ordinarily I anoint both sides of the leaves.

[It appears that Captain Norman had kept the plants in his room, and being thus under the influence of a mercurialised atmosphere, he had suffered in the way he described. It was stated that no such effects had in any instance been observed in the course of poisoning the plants of the Edinburgh University Herbarium; and Mr Gilbert Stuart stated

that he had slept for six months in a room where plants poisoned in a similar way were kept, and he had not felt any bad consequences. It would appear that Captain Norman must be peculiarly liable to be affected by mercury.]

VIII. *Report on the Cinchona Plantations of Ceylon, in a Letter to the Secretary of State for India.* By CLEMENTS R. MARKHAM, Esq.—Communicated by Dr GREVILLE, from a Colombo paper transmitted to him.

I have visited and inspected the Government Cinchona plantation in Ceylon, as well as some of the coffee estates where the cultivation has been undertaken, and now have to report the results of my observations.

The plants in Ceylon, with the exception of those of *C. Calisaya*, which came from Java, are entirely derived from seeds procured from South America under my superintendence, at the expense of the India Office, and the Ceylon cultivation may, therefore, be considered as a branch of the great undertaking which has been successfully carried out under the auspices of the Secretary of State for India.

In Ceylon, the Cinchona experiment is under the able superintendence of Mr Thwaites, the Director of the Botanical Garden at Peradenia, and the cultivation is conducted, under him, by Mr M'Nicholl, a very intelligent gardener, who resides on the spot. The first plants arrived in 1861, when the site for a plantation was selected by Mr Thwaites, and the work commenced.

The knot of mountains in the Central Province of Ceylon, which at one point attains a height of 8280 feet above the sea, is entirely composed of gneiss with veins of quartz. The soil formed by the disintegration of this rock is not rich,—not to be compared with the fertile loam produced by the more modern volcanic rocks of Java; but this poverty of soil is made up for by abundant supplies of water and a genial climate. The valleys formed by the mountain spurs are extensively cleared and planted with coffee; but there is still a good deal of forest on the higher elevations, and on one of the highest plateaux is the hill station of Neuera-Ellia, 6220 feet above the sea. From Kandy the mountains are ascended, on their northern face,

by an excellent road, and, as Neuera-Ellia is approached, the flora resembles closely that of the Pulneys, or of the Neilgherries, near Coonoor. The woods are, like those of the Southern Indian hills, composed of *Michelia*, *Symplocos*, *Gaultheria*, *Vaccinium*, myrtles, with an undergrowth of *Lobelia excelsa*, balsams, *Osbeckia* and *Sonerila*, *Solanum indicum*, a passion-flower, and madder. Beautiful tree ferns grow in the shade, and the *Rhododendron arboreum* is scattered over the open grass land. The station, consisting of bungalows nestling amongst Australian trees, is on a plain, bounded on the east and west by tree-covered hills crested here and there by bare ridges of gneiss. The masses of cryptogams on the branches and stems of the trees indicate the extreme dampness of the climate.

The Cinchona plantation is at a place called Hak-galle, six miles south of Neuera-Ellia, and 5200 feet above the level of the sea. The position is admirably chosen. Hak-galle is a magnificent perpendicular cliff, rising out of a fine forest which clothes the steep slopes of the mountain. The site faces the north-east. It is protected from the full force of the south-west monsoon by the cliff, while it receives a good supply of rain during both seasons. Half a mile on the road towards Neuera-Ellia the effects of the north-east monsoon are lost, and about a mile in the other direction is the limits of the influence of the south-west monsoon. Thus Hak-galle is exactly situated so as to receive ample supplies of moisture throughout the year. No place in the East has so vividly reminded me of the Cinchona *pajonales* of Peru as the view from the Hak-galle plantation. A mountain torrent dashes through the wide ravine, and the hills on either side are clothed with alternate forest and grass land, while to the south are the distant hills and valleys of the Oovah district. These open grass lands, called *patenas* in Ceylon, are precisely analogous to the *pajonales* of Peru. They are of frequent occurrence in the Ceylon hills, being covered with coarse tufts of lemon grass (*Andropogon Schœnanthus*), and the forest stopping abruptly on their verge. No trees grow on these *patenas*, except the *Rhododendron* and a very few others, and they are considered unsuitable for coffee cultivation. On the day of my visit to Hak-galle there were

showers from the south-west in the forenoon, and in the afternoon a dense mist rolled up from the Oovah valleys to the east, and enveloped the plantation. This is exactly the course of atmospheric daily change in the uplands of Caravaya, and as I watched the white mist wrapping tree after tree in its thick folds, I almost fancied myself standing on a Cinchona *pajonel* in Peru.

Some eight or ten acres have been cleared on the forest-covered slope, under the grand old Hak-galle cliff, and about five are now planted with Cinchona trees. It is worthy of remark that, although the roots of the felled trees have been allowed to remain in the ground, the Cinchona have in no instance been attacked by fungi, as was the case in Java. The plants are completely in the open, and look remarkably healthy and vigorous. In the lower part of the clearing are the plants of *C. succirubra*, which average a height of from 8 to 10 feet. Several are in flower. The largest tree is 18 feet 6 inches high, with a stem 14 inches in girth at the base. It was planted in February 1862. The *Calisaya* trees are smaller, but look healthy, and the specimens of *C. micrantha* look remarkably strong. The *C. officinalis* trees, of which kind about 4000 are planted out, are in the upper part of the clearing; they grow very fast, and have already yielded an abundant supply of seeds.

The nurseries for cuttings and young plants are beds containing many thousands placed close together, and merely shaded from the heat of the sun by a movable roofing of grass. An ordinary coolie puts in the cuttings, and the loss only amounts to a half per cent.; 2000 plants of *C. succirubra* have been raised from buds placed in drills, in the same way as French beans are raised, with half an inch of earth over them, and 90 per cent. came up; and of the *C. officinalis* seeds (thirty in each capsule) *all* came up. The total number of plants and cuttings is now upwards of 500,000. With reference to the method of taking the bark, I found that a tree of *C. succirubra*, which was cut down at Hak-galle for bark analysis in April 1864, had, in November 1865, sent up another shoot perpendicularly from the side of the old stem, which was 5 feet high and 5 inches in girth near the ground.

The most cheering feature in the Cinchona cultivation of Ceylon is the hearty way in which it has been taken up by the coffee planters. The facility for acquiring good titles, the excellence of the roads, and other advantages, probably render them, as a body, more enterprising than their brethren in India, and this important experiment is evidently destined to receive a fair and complete trial at their hands. The plants are given away by the Government, the only expense to the cultivator being their carriage to his estate. As many as fifty planters have made applications for plants; 500,000 plants have been asked for, and 180,000 actually distributed.

One of the most energetic Cinchona cultivators is Mr Corbett, who manages the estate of Rothschild, at Pusilawe (on the road from Peradenia to Neuera-Ellia), for the Ceylon Company. It may be looked upon as a representative estate. The coffee plants occupy the slopes on both sides of the Pusilawe valley, extending to the very crown of the grand hills of Moonera-galle, whose battlemented ridges of gneiss bound the view to the westward. Excepting a clump of Jacks high up on the eastern side, and some palms near the houses, every tree has been felled as far as the eye can reach, and rows of coffee plants entirely occupy the site of the primeval forest. No regard whatever has been paid to forest conservancy, belts of verdure are neither left along the water-courses nor on the hill tops, and planters have to send many miles for their firewood, yet there has been no sensible diminution of the water supply, and cascades and torrents dash over masses of rock through this coffee covered valley.

About four acres have been planted with Cinchona trees, on the Rothschild estate, on a steep hill slope, facing the east, all except one being of the red bark species. There are about 2500 plants, or 600 to an acre, planted 12 feet apart, alternating with coffee bushes. They are exposed to the full blaze of the sun, yet nothing can be more vigorous and healthy than their appearance. The oldest had been in the ground nearly three years, and are 12 feet high and 8 feet across the branches, with stems 13 inches in girth near the ground. But the majority of the plants were about 20 months old, with stems 8 inches in girth.

Mr Corbett is about to plant 600 acres with Cinchona plants at another estate, called Deekoya, which is 4000 feet above the sea. Rothschild only has an elevation of 3200 feet. He has applied for 100,000 plants, and has already received 10,000; and he calculates that, after three years, the cost of cultivation will be L.6 an acre, exclusive of original price of land and interest of money. This will ensure a very remunerative return on the sale of the bark.

As the object of the Ceylon Government in establishing the Hak-galle plantation is confined to supplying Cinchona to individuals who are willing to undertake the cultivation, the extensive plantations of the Neilgherries, where a far grander and more important system is contemplated, would, therefore, be out of place here. The expenditure on Hak-galle is only L.500 a-year, L.250 of which is the salary of Mr M'Nicholl, the gardener. But the Hak-galle plantation fully secures the object for which it was established; it is admirably managed by Mr M'Nicholl, and it forms a most efficient source of supply for the issue of young plants. I have no doubt whatever that Cinchona cultivation, under the auspices of the enterprising planters of Ceylon, will prove a great commercial success, and be a benefit of no small value to the inhabitants of the island.

I sail for Tuticorin on the 19th instant, in a native small craft, in order to visit the Pearl Oyster Nursery, and to deliver the instruments and instructions respecting the aquaria to Captain Phipps. Dr Cleghorn, the Conservator of Forests, with the permission of Sir William Denison, is to meet me at Palamcottah, and to travel with me, by way of Travancore, to the Neilgherry hills.

IX. *Report on the Cultivation of Cinchona at Darjeeling during the month of November* 1865, from T. Anderson, Esq., M.D., Superintendent Botanic Gardens, and in charge of Cinchona cultivation in Bengal, to the Junior Secretary to the Government of Bengal.

I have little to report this month beyond the usual steady increase in the number of plants, and the continued good condition of the plants. The increasing cold, accom-

panied by great dryness, has reduced the rate of growth below that of last month. At the upper plantation growth has nearly ceased, but at the two lower plantations some of the plants have grown more than 3 inches during the month. The approach of the cold season has also affected the operations of artificial propagation by cuttings, only 8280 cuttings having been made, which is 1335 cuttings less than the number procured in October. The total number of plants and cuttings of all species is 117,242.

Table showing the Maximum and Minimum Growth during November 1865.

Name of Specica.	First Plantation.	Second Plantation.	Third Plantation.	Fourth Plantation.	Fifth Plantation.
C. succirubra,	...	...	¼ inch.	¼ to 1 in.	½ to 3¼ in.
C. micrantha, .	...	...	None.	None.	None.
C. officinalis, .	½ inch.	1 to 1½ in.	½ to 1½ in.	¼ to 2 in.	¼ to 1½ in.
C. pahudiana,	½ to ¾ in.	½ to 1¼ in.	¼ inch.	¼ to 2¼ in.	2 to 3 in.

Number and Distribution of Cinchona Plants in the Government Plantations at Rungbee on the 1*st December* 1865.

Name of Species of Cinchonæ.	Number in permanent Plantations.	Number of Stock Plants for Propagation.	Number of Seedlings or Rooted Cuttings in Nursery Beds for permanent Plantations.	Number of Rooted Cuttings in Cutting Beds.	Number of Cuttings made during the Month.	Total Number of Plants, Cuttings, and Seedlings.
C. succirubra, .	389	10,000	14,500	18,245	2,900	46,034
C. Calisaya, . .	None.	26	...	116	None.	142
C. micrantha, .	15	2,539	...	1,710	280	4,544
C. officinalis, including varieties,	870	10,000	8,459	37,001	5,100	61,430
C. pahudiana, .	5,092	None.	...	None.	None.	5,092
Total, . .	6,366	22,565	22,959	57,072	8,280	117,242

The weather during the month was cold and dry, with bright sunny days, until the 21st, after that date during the nights and mornings the sky was clear, but thick fogs prevailed during the day above the second plantation.

On the 25th a thunder-storm, accompanied by hail and rain, passed over Darjeeling; at Rungbee a little hail, followed by a few drops of rain, fell. The quantity was too small to be appreciable in the rain-gauge.

At the fourth plantation the mean maximum temperature was 77·63. The mean minimum was 52·2, and the mean temperature of the month was 64·91.

X. *Report of the State of Vegetation in the Open Air at the Royal Botanic Garden.* By Mr M'Nab.

Mr M'Nab stated that, since last meeting of the Society (12th April 1866), vegetation had made little progress, in comparison with what is usually seen at this period of the year. It is only since the 5th of May that any marked change has been observed. Many of the trees—such as sweet chestnuts, walnut, beech (where not sheltered), lime, elm, oak, poplar (except the balsam), ash, sugar-maple, occidental plane, hornbeam, laburnum, tulip tree, and locust tree, with numerous others, are showing very little progress in their leaf development. The leaves of those which are progressing are as yet small and pale-coloured, owing to the want of solar heat at the time when they first put out their leaves, and the prevalence of low night temperatures, averaging from 23° to 45° Fahr. Since 12th April, on two mornings only has the thermometer been below the freezing point, namely, on 29th April, when the thermometer stood at 7 A.M. at 25°, and on the 30th April, when it stood at 29°. On 1st May the garden was white, once with snow, and twice with hail, as well as on several occasions since. The frost on the morning of 29th April has done much mischief to the young growths of many of the tender shoots of hardy herbaceous plants, as well as to the advanced blooms of the earlier flowering hybrid rhododendrons, particularly those having *R. campanulatum* and *R. arboreum* as male parents. The young leaf growths of most of the supposed hardy Indian species of rhododendron, as well as the young leaf shoots of all those hybrids which had begun to elongate, are now completely browned in the heart, although showing no symptoms of decay outside.

This injury will be much against the flowering of all the early varieties next spring. The Norway maples are now much covered with flowers, as well as horse-chestnuts, elms, birches, ashes, alders, and thorns; and many others not yet developed will no doubt prove equally productive, the fine summer last year having matured the wood thoroughly. The dry summer and autumn have also been the means of ripening the young growths of many of the recently introduced conifers, and we hear of numerous varieties now producing flowers which do not usually do so, such as *Wellingtonia gigantea*, *Picea nobilis* and *P. amabilis*, *Abies Douglasii*, *A. Menziesii*, and *A. cephalonica;* also various species of *Thuja*, *Cupressus*, *Retinospora*, *Taxus*, and *Cephalotaxus*. In the flower borders we have now in good condition the early tulips, garden hyacinths, grape hyacinths, the mountain and stemless Star of Bethlehem, the rose-coloured *Trichonema*, the crown imperial; also the chequered and Pyrenean Fritillary, *Helonias bullata*, the blue nodding squill (*Scilla amœna*), and summer snow-flakes. Many kinds of narcissus are also in bloom, chiefly varieties of *Narcissus Pseudo-narcissus* or the daffodil, also *Narcissus odorus*. The small single *Narcissus poeticus* has also expanded its flowers. Wallflowers, *Aubretia grandiflora*, *Arabis alpina*, *Doronicum caucasicum*, *Primula nivalis*, and *P. ciliata* are in perfection, as well as the purple varieties of *Orobus vernus*, and the *Gentiana acaulis*, but only on dry south exposed banks.

XI. *On the Occurrence of* Allium paradoxum, *Don, in Woods near Edinburgh.* By Professor Balfour.

This plant was found by Mr Alexander Craig Christie in woods near Binny Crag, about twelve miles west from Edinburgh. I visited the spot along with him, and found the plant generally distributed through the wood. It seems to have been introduced for some time, and it has now become naturalised. The Rev. Dr John Smith, minister of Ecclesmachan, thinks that it may have been introduced by Mrs Stewart of Binny House, who has planted various exotic species in the woods. It has been also planted in

the Manse garden, and has become a troublesome weed, propagating freely by its underground bulbs and its aerial bulblets. The Rev. Dr Duns informs me that he and the Rev. P. Hyslop found the plant on the banks of the Water of Leith, above Colinton. The following are the characters of the species:—*Allium paradoxum*, Don, Monog. 72, Roem. et Schult. Syst. 7, 1090. Bulb simple, ovate; scape with a single leaf at the base, triquetrous; leaves linear-lanceolate, acute, keeled, many-ribbed, about equalling the scape; umbel bulbiferous, 1-2 flowered; spathe 3-valved, flowers on long pedicels; leaves of perianth elliptico-oblong, obtuse, equal, campanulately connivent, three times longer than stamens; style tricuspid at apex. It seems to be *Scilla paradoxa* of Bieberstein, Flor. 3. 267, found in Iberia, Tiflis (*Nordm.*); in the woods near Lenkoran (*Hohenacker*); in Siberia (*Don*). It resembles *Allium triquetrum*, but differs in its umbel being bulbiferous, and only 1-2 flowered, and in the absence of the green rib on the leaves of the perianth. In some respects also it resembles *A. ambiguum*, the flowers of which, however, have a pinkish hue, a terete aphyllous scape, and a one-valved spathe.

Mr M'Nab placed on the table a plant of a large purple-flowered primrose, presented to the Botanic Garden by Miss Walker of Drumsheugh. This plant flowered freely during the months of February and March, in the open air, as a true primrose. Early in April it began to push up from its centre numerous flower-stalks from six to eight inches in height, having on each stalk an umbel of flowers, varying from three to seven, on pedicels of different lengths, each flower being identical in size with those produced in its primrose state. The original leaves were flat and very rugose, and almost hid by the numerous single-stemmed flowers; while the leaves produced in the umbellate state were larger, more upright, and less wrinkled. Towards the end of April this plant presented a peculiar appearance, having numerous single flowers all round, with the stalked ones in the middle, both kinds being now in flower on the plant. Mr M'Nab also laid before the meeting some plants, crosses between the *Primula vulgaris* and *Primula elatior*, also between *Primula vulgaris* and *Primula veris*, showing

a similar arrangement to the one above described, but in none of these examples were the flowers so large as in the ordinary *Primula vulgaris*, which was the female parent in both cases. Although nothing is known of the parentage of the Drumsheugh primrose, it is certainly a very desirable plant. Besides being different in colour, it is also much larger than any of the cultivated varieties grown in our gardens. As crosses can easily be produced by tentative measures, it is remarkable that hybrids are scarcely ever seen in their natural state, notwithstanding that the *Primula vulgaris* and *Primula elatior*, as well as *Primula vulgaris* and *Primula veris*, are frequently seen growing together.

Sir Thomas Buchan Hepburn, Bart., of Smeaton, sent flowering specimens of the following coniferous trees, with notes of their height and circumference:—*Picea amabilis*, planted in 1843, then 8 inches in height, now 21 feet 4 inches high and 3 feet 1 inch in circumference. *P. cephalonica*, planted a seedling in 1841, now 21 feet 8 inches high and 3 feet 6 inches in circumference. *P. nobilis*, planted 1841, then 1 foot 4 inches high, now 37 feet 4 inches high and 3 feet 9 inches in circumference. *Cupressus torulosa*, planted in 1852, then 2 years old, now about 17 feet high and 9½ inches in circumference.

Dr Balfour exhibited specimens of *Gastrolobium oxylobioides*, which had been brought from near Perth, Western Australia, by Mr Frederick Page, as being one of the plants which poison cattle and sheep in that country. It does not affect horses. Mr Page stated that 100,000 acres of land in Western Australia cannot be used for sheep pasture on account of the presence of this plant.

A letter was read from Dr Cleghorn, conservator of forests, Madras, relative to the proposed introduction of *Lodoicea seychellarum*, the double coco-nut or coco de mer, into India. Regarding the proposal of the Madras Government to obtain the "Coco de Mer" from the Seychelles islands, Dr Cleghorn remarks, that this magnificent palm *(Lodoicea seychellarum)* is regarded with great interest by naturalists, and being threatened with extinction, its introduction into the continent of India would be important to science, while the high price of the nuts compared with those of the Coco nut Palm renders the tree of considerable value. The Travellers'

Tree of Madagascar *(Urania speciosa)*, mentioned in Mr Swinburne Ward's letter to Sir W. Hooker, grows well at Trevandrum and Colombo. Dr Cleghorn infers that the localities in this Presidency which would probably best suit the Seychelles Palm, are the Government garden at Trevandrum and the Collector's garden at Calicut. This officer might hereafter transmit growing plants to the Laccadive islands. There is no reason to suppose that the saline soil of the People's Park would prove unsuitable, and the king of palms would be an object of special interest. Dr Cleghorn therefore suggests that not less than eight or ten nuts be sent by steamer to Madras, and placed on arrival under the charge of Mr Denham at the Agri-Horticultural Society's Gardens.

Mr Adam White exhibited specimens of alpine plants, collected by him on Ben Ledi on 7th May. They included *Saxifraga oppositifolia*, *S. nivalis*, and *Alchemilla alpina*. He also mentioned having seen the cuckoo, willow wren, and yellow wagtail in the Pass of Leny on the same day.

Dr Joseph Dickson sent specimens of *Gymnogramme leptophylla* from Jersey.

Mr John B. Lyall, Free Church School, Peebles, sent specimens of *Equisetum umbrosum*, collected by him in the vicinity of Peebles.

Mr Finlay Dun sent roots of a willow tree taken from a drain which they had completely choked up.

Mr Gorrie exhibited flowers of Carstair's new double pelargonium, and of a Japan cherry, introduced by Mr Fortune.

Mr Traill, Aberlady Lodge, exhibited a fasciated peduncle of a polyanthus bearing 170 flowers, in some of which there were two distinct corollas covered by a calyx formed of ten sepals; in others there was a corolla of ten united petals covered by a similar calyx. He also exhibited specimens of what appeared to be a hybrid between *Primula vulgaris* and *P. elatior*, from Argyllshire.

Mr P. S. Robertson presented specimens of *Wellingtonia gigantea*, with male and female cones, produced at Tillichewan Castle.

14*th June* 1866.—Dr ALEXANDER DICKSON, Vice-President, in the Chair.

Letters were read from Dr Goeppert, of Breslau, and from M. F. A. Miquel, of Utrecht, thanking the Society for their election as Honorary Fellows.

The following Donation to the Museum at the Royal Botanic Garden was noticed :—

From Dr Mueller, Melbourne, transmitted by Dr H. Madden —Section of the stem of *Laportea photinifolia* (tree nettle).

The following Donation to the Library was presented :—

A Ramble in the New Zealand Bush. By Dr Stanley L. Haynes.—From the Author.

The following additions to the University Herbarium were announced :—

About 1100 specimens of Mosses and other Cryptogams from South America, collected by Richard Spruce, Esq. From William Rhind, Esq.—Specimens of Dried Plants from Hudson Bay territory, collected by Major George Seton.

From Mr Alexander Craig Christie—Specimens of *Rubus Chamæmorus*, collected on a hill near Habbies How; and specimens of *Allium paradoxum*, from the woods of Binny Crag.

From Mr Lees, gardener to the Earl of Haddington—A specimen of *Paulownia imperialis* which had flowered in the garden of the Earl of Haddington at Tynninghame. In regard to this plant, Mr Lees states—"The *Paulownia imperialis*, now in flower here, was planted in its present site in the spring of 1855, then about 3 feet high. It is now 13 feet high, and the spread of branches at top is 15 feet. It is growing upon a rich light soil, about 2½ feet, resting upon a deep bed of gravel. It has set flower buds frequently before this, but they always dropped off in spring. Several times I tried to preserve them by covering them with cotton wadding, but found it of no use; and I have little doubt that it is entirely owing to the fine dry autumn of last year that the flowers have come forward this spring."

From Dr John Lowe, Lynn—Parcel of Scandinavian Plants.

From Dr John Kirk—Plants from Africa, Australia, &c.

The following Communications were read :—

I. *Obituary Notice of Dr Greville.* By Professor Balfour.

Since we last met, we have been deprived of our distinguished and highly esteemed President, Dr Greville. We all deeply feel the loss which we have sustained. Our Society has lost one of its earliest and most celebrated members, and one who has contributed most able papers to its Transactions. Having known Dr Greville when I was a student of botany, so far back as 1828, and having profited much by my intercourse with him since that time, I feel that I have been deprived of one of my earliest botanical friends. I accompanied him in numerous excursions, I visited along with him all the best alpine botanical districts of Scotland, I was with him in many a scene of adventure, and I consulted him in cases of difficulty. I also was associated with him in many schemes of philanthropy and Christian benevolence. I had much pleasant social intercourse with him, and I am conscious of a blank which cannot be supplied as regards the things of earth. No one knew him better than I did, or met him oftener in the intercourse of life, and no one felt a higher regard and esteem for him. I now mournfully pay this tribute of respect to the memory of one of my best friends.

Our Botanical Society has experienced a sad loss in his sudden and unexpected death. Little did we think, when we met him here, in all his wonted vigour, on the 10th of May last, that we should not see his face again amongst us. On that occasion he read a paper on Diatoms, which is published in the present Number of our Transactions; and he entered with his usual enthusiasm into the details of the Highland trip which I made with my pupils last year, when we visited many of the localities which he had examined in former years. At that time I recalled to his recollection the memories of former days, when he and I and others had slept in the miserable shieling, and wandered amidst the botanical rarities of the alpine glens of Scotland. He always enjoyed these rambles, and he was ever ready to accommodate himself to all the circumstances of discomfort in which he might be placed. A heather bed

on the floor of the old hut did not come amiss to him. I well remember the visit which he and I made to Glenisla; when, arriving late at night at the foot of Canlochan, and rousing up a shepherd in his solitary hut, the doctor at once rose to the emergency—pulled the heather, and made our beds with the hand of one who knew the art of making a pleasant cushion for repose. He was always ready and active, full of spirit, zealous in the prosecution of practical science, and willing to impart information to others.

Accustomed as I have been for so many years to hold constant intercourse with him, I can hardly as yet realise his departure from us. He seems to be present, and everything around me recalls him to my thoughts. The herbarium which I consult, the drawings which I exhibit, and the books whence I derive information, bring him forcibly to my recollection. He seems still to be among us, animating us by his example.

Let me bring before you a few of the incidents of his life. He was the son of the Rev. Robert Greville, rector of Wyaston, Derbyshire, and was born at Bishop-Auckland, in the county of Durham, on 13th December 1794.

He was carried while an infant to Derbyshire, in which county he was brought up, receiving a home education. He studied plants before he knew that any book was written on the subject, and before he was nineteen he had made careful coloured drawings of between one and two hundred native plants. He thus showed an early predilection for that science in which he afterwards attained high celebrity. He was intended for the medical profession, and he passed through the usual curriculum of four years in London and Edinburgh; but circumstances having rendered him independent of the practice of the profession, and, above all, natural history having taken deep root in his heart, he did not go up for his degree, but devoted himself to botany, stimulated by the hope that sooner or later he might obtain a professorship.

In 1816 he married a daughter of Sir John Eden, Bart. of Windlestone, Durham. In the same year he came to Edinburgh, and studied anatomy and comparative anatomy most zealously under Dr Barclay, the celebrated teacher.

There he was associated with Mr Walker-Arnott, now Professor of Botany in Glasgow; Mr Nasmyth, our celebrated dentist; Mr Syme, our distinguished professor of clinical surgery, and other eminent men. He thus laid the foundation of natural science on the solid basis of anatomy.

He joined the Wernerian Society on 15th April 1819, and in 1820 he commenced reading papers on Algæ, which were published in the Transactions of the Society.

He joined various excursions with Hooker, Graham, and others. In 1821 he was one of a botanical party, with Hooker, who visited Benlawers, and he gave a sketch of the encampment.

In 1823 he commenced his splendid work, entitled "Scottish Cryptogamic Flora," which was continued in monthly parts for six years, and extended to six vols. 8vo. At that time Cryptogamic Botany was little studied in this country, and he may be said to have been one of the pioneers in this department. He not only studied thoroughly the microscopic structure of the lower orders of plants, but he delineated that structure in a most artistic and accurate manner. No one had a finer pencil, or gave more correct figures of the forms and tissues of plants. His "Scottish Cryptogamic Flora" deservedly occupies the highest place in that department of botany, and is a work of reference in all parts of the world.

In 1826, after having carefully examined for many years the plants in the neighbourhood of Edinburgh, he published his "Flora Edinensis"—a work of high merit, embracing not merely the Phanerogamous but also the Cryptogamous plants of the district. Nothing has appeared equal to it since that time. In the Cryptogamic department it has had no rival. Considering the increase of our knowledge of Cryptogamic Botany, we require some one now to follow Greville's steps as regards the Flora of Edinburgh. In 1826, the University of Glasgow conferred on him the degree of LL.D., an honour which he richly deserved.

He was associated with Hooker, Arnott, Jameson, Fleming, and others, in the prosecution of natural science, and he made extensive collections of plants, insects, shells, and marine crustacea. He also contributed papers to various societies and periodicals on many subjects of natural his-

tory. He had a wonderful power of communicating information to others, and at one time he gave popular lectures on Botany in Edinburgh. The lectures were well attended, and were beautifully illustrated. In 1830 he published his valuable work, entitled, "Algæ Britannicæ: a Description of the Marine and other Inarticulated Plants of the British Islands, belonging to the order Algæ, with Plates illustrative of the Genera." The originals of these drawings have been kindly handed over to me by the members of his family as a memento of my dear friend. In the same year he joined Professor Graham's autumn trip, and visited the alpine district of Braemar. On that occasion he and I were fortunate in picking, in Glen Kander, independently of each other, specimens of *Carex Vahlii*, a plant which had not been previously found in Britain. *Salix rosmarinifolia* was also gathered during the trip. I was afterwards associated with him in many botanical excursions. In the autumn of 1837, Dr Greville, along with Mr Brand and myself, made an excursion for three weeks to the Highland districts of Scotland. We visited Clova, Glenisla, Braemar, Glen Callater, Loch-na-gar, Ben-na-Bourd, Ben-na-mac-Dhui, and other mountains, and made a collection of about 15,000 specimens of alpine plants for the Botanical Society of Edinburgh. The object was to supply specimens for exchange with home and foreign botanists. Dr Greville's specimens were admirably dried. He adopted the plan suggested in his "Directions for Drying Botanical Specimens,"* of setting apart a portion of two days (Wednesday and Saturday) each week for the purpose of putting the specimens in order.

In 1831, in conjunction with Dr Hooker, he published "Icones Filicum," in 2 volumes folio, "containing figures and descriptions of Ferns, principally of such as have been altogether omitted by botanists, or as have not yet been correctly figured." The work was dedicated to their mutual friend, Dr Wallich, the well-known Indian botanist. The coloured drawings for the work were entirely, I believe, executed by Greville.

Dr Greville was an active field naturalist, and underwent much fatigue in the way of walking. He accom-

* Bot. Soc. Third Annual Report, p. 88.

panied Professor Graham and myself in many of our trips, and his presence added in no small degree to the pleasure and profit of the excursions. In the summer of 1834 he visited Sutherlandshire on a natural history expedition with Sir William Jardine, Mr John Jardine, Mr James Wilson, and Mr Selby. The sanction of the Duchess-Countess of Sutherland was obtained. A light boat, suspended on a four-wheeled carriage, and drawn by two horses, was the conveyance adopted, and was found most useful and convenient in a country so intersected with lochs, but entirely destitute of boats. It could be shipped and unshipped at any time with perfect ease even by three of the party. Mr Selby gave to the Wernerian Society an account of the quadrupeds and birds observed, Mr James Wilson noticed the insects, and Sir William Jardine published observations upon the Salmonidæ met with during the expedition. The account of these observations are given in Jameson's Journal for 1834, 1835, and 1836.

From time to time Dr Greville read papers to the Royal, Wernerian, Royal Physical, and Botanical Societies of Edinburgh; and he contributed articles to Professor Jameson's Journal and to other periodicals. Many of his papers had reference to Ferns, Mosses, Algæ, and Diatoms. His writings secured for him a high reputation. The following are some of the papers contributed by Dr Greville to the Transactions of the Wernerian Society:—

An Account of some of the Cryptogamous Plants of Devonshire.

Description of a new species of Fucus found in Devonshire.

Description of a new species of Potentilla from the west coast of Greenland, with some account of the Arctic Flora.

On the Leaves, Capsule, and Root of *Buxbaumia aphylla.*

Tentamen Methodi Muscorum; or, a new arrangement of the genera of mosses, with characters, and observations on their distribution, history, and structure. Dr Walker Arnott was associated with him in this paper.

Description of two new species of Musci, belonging to the Genera *Neckera* and *Hypnum.*

On new Scottish Fungi, and on a new species of Grimmia.

The following is a list of papers contributed by Dr Greville to the Transactions of the Botanical Society:—

Report of the progress and state of Botany in Britain, from March 1839 to February 1840.

Notice of a new species of *Dawsonia.*

Notice of a new species of *Spiridens.*

Notice of two new species of Ferns, belonging to the genera *Oleandra* and *Grammitis.*

Notice of a new species of *Antrophyum.*

Algæ Orientales: Description of new species belonging to the genus *Sargassum* (two papers).

Remarks on some Algæ belonging to the genus *Caulerpa.*

Notice of the discovery of *Desmarestia Dresnayi* on the coast of Ireland.

Notice of a new species of *Caulerpa.*

Report on a Collection of Diatomaceæ made in the district of Braemar, by Professor Balfour and Dr George Lawson.

Description of some new species and varieties of *Naviculæ*, &c., observed in Californian guano.

New genera and species of Diatoms from the South Pacific (four papers).

He was known in the scientific world as a first-rate Cryptogamist, and he had the honour of being elected a Fellow of numerous Societies. Among them may be mentioned the following:—Royal Society of Edinburgh, 1821, and afterwards Member of Council; Member of the Imperial Academy of Naturæ Curiosorum of Germany, under the title of Hudson, April 1821; Member of the Natural History Society of Leipzig, and Corresponding Member of the Natural History Society of Paris, 1822; Corresponding Member of the Academy of Natural Sciences of Philadelphia, 1823; Member of the Physiographical Society of London, 1st June 1824; Honorary Member of the Royal Irish Academy, 27th June 1825; Honorary Member of the Natural History Society of Montreal, and Corresponding Member of the Medico-Botanical Society of London, 1828; Member of the Linnean Society of Normandy, 1829; Member of the Botanical Society of Edinburgh (afterwards Honorary Secretary and then President), and Corresponding Member of the Society of Natural and Medical Science of Brussels, 1836; Corresponding Member of the Society of Natural

Sciences of Cherbourg, 1854; Honorary Member of the Philosophical Society of Cambridge, of the Yorkshire Philosophical Society, of the Liverpool Institution, of the Lyceum of Natural History of New York, Member of the Wernerian Society, the Royal Physical Society, &c.

I have often been surprised that he did not become the occupant of a chair of Botany, for which he was so well fitted in every respect. This seems to have depended on his not putting himself prominently forward as a candidate for such an appointment. His independent means, and his desire not to be tied down to the arduous duties of teaching, probably operated in preventing him from applying for office. He was certainly well qualified for the situation of an instructor in science, and would have inspired his pupils with enthusiasm. During the later years of his life he was unfortunately deprived of much of his pecuniary resources, and he was under the necessity of using his pencil and brush with the view of adding to his income. At one time he took up landscape painting as a profession, and he contributed on several occasions paintings to the Exhibition of the Scottish Academy, which were remarkable for the faithful delineation of the rocks and trees of the Highland scenery of Scotland. To him I am indebted for a large number of my class drawings, which have proved most useful for the purposes of teaching, and which now every day during the course remind me of him who has left us.

A few years ago Dr Greville and I commenced a work, which was to be entitled "Plant Scenery of the World," in which the characteristic floras of different regions were to be represented, and a description was to be given of the plants in the landscape. He completed forty or fifty of the coloured plates, and I prepared some of the letterpress, but owing to the difficulty of getting good coloured lithographs—such at least as were reckoned satisfactory by Dr Greville—it was abandoned by the publishers, Messrs Edmonston & Douglas, who possess the drawings. I still think that the work might be carried on, and that it might prove valuable as illustrating the geographical distribution of plants.

Advancing years led to a less exclusive devotion to the subject of Botany, and to the disposal of his collection of

Phanerogamous plants. These I purchased when I was Professor of Botany in Glasgow, and when I returned to Edinburgh they became the property of the University. Subsequently Dr Greville disposed at different periods of his ferns, mosses, lichens, fungi, and algæ; and this highly valuable collection is now preserved in the Herbarium-Room at the Botanic Garden. The collection is a most important one, and it has been increased by the addition of specimens belonging to the Botanical Society and myself, as well as by the purchase and donation of collections from various parts of the world. It constitutes our University Herbarium, and consists of about 50,000 species, represented by probably ten times that number of specimens. The Herbarium consists of a set of typical genera, which are being arranged according to Hooker and Bentham's Genera Plantarum, and of the floras of different quarters of the globe, arranged in separate cases. The floras, separately represented, are those of Britain, Europe, Syria and Palestine, Western and Northern Asia, India, China and Japan, Malay Islands, Australia, Africa, North America, and South America. There are also collections of Scripture plants, medicinal and poisonous and economical plants. The Cryptogamic plants, for which we are specially indebted to the Grevillean Herbarium, are kept as a whole in separate cases.

Dr Greville also sold his collection of insects to the University of Edinburgh. This collection is now deposited in the Museum of Science and Art in Argyle Square. I trust that his collection of land and fresh-water mollusca will be acquired for some public museum.*

Of late years Dr Greville directed special attention to Diatomaceæ, of which he formed a very valuable collection, which I hope will be purchased by the British Museum.† These minute organisms, requiring much elaborate microscopic examination, were studied by him with remarkable zeal and assiduity. To the Transactions of the Microscopical Society of London and those of this Society, he has contributed many papers on the subject, with exquisite drawings. His last paper appears in the present Number of our Transactions. The collection of Diatoms he has left

* This collection is now in the Museum of Science and Art of Scotland.

† This collection is now in the British Museum.

is wonderful. All the specimens are admirably put up on slides, and each is beautifully named, with references to any figures given of the specimens by himself. Considering the contributions he has made to Diatoms, and the plates which he has published, these specimens have no ordinary value. To the Edinburgh Microscopical Society he gave many demonstrations on the structure of Diatoms, illustrated by drawings and specimens. The Council of the Royal Society of Edinburgh awarded to him in 1862 the Neill Medal for his contributions to Cryptogamic Botany, and especially his papers on Diatoms.

In presenting, on the 2d March 1863, the Neill Prize, Sir David Brewster made the following remarks:—

"Dr Greville's contributions to natural history have been both numerous and valuable, and their merits have been recognised by the most distinguished botanists of the age. His 'Scottish Cryptogamic Flora' was published between 1823 and 1828. His 'Flora Edinensis' appeared in 1828. His 'Algæ Britannicæ; or, Description of Marine and other Inarticulated Plants in Britain belonging to the order Algæ,' was published in 1830; and he has inserted in the 'Microscopical Journal' no fewer than twelve papers on the Diatomaceæ, an interesting subject which still occupies his attention.

"But Dr Greville's services to science have not been limited by his writings. He has been an ardent collector of plants and other objects of natural history; and his complete herbarium of Phanerogamous and Cryptogamous plants, as well as his collection of insects, have been placed in the Museum of our University. He has also made a collection of land and fresh-water mollusca, which is the finest in Scotland.

"These various contributions to natural history have been highly appreciated both in this and in foreign countries. In 1824 the University of Glasgow conferred upon Dr Greville the degree of Doctor of Laws, and many of the Natural History Societies in Europe and America have received him among their corresponding or honorary members.

"Though somewhat foreign to the present occasion, the Society will, I trust, excuse me for adding, that Dr Greville has taken an active part in those interesting questions of

philanthropy, on the solution of which the happiness and security of society depend. He has felt, as I am sure most of us here feel, that there is something greater than science, and something higher and more enduring than fame; and it is no slight ground of congratulation, that some of those who have been commissioned by their Maker to study His works, and to sound the depths of His wisdom and His power, have shunned the fatal course which others have pursued, of sapping the foundations of that faith and hope which science is so able to sustain."

When the late Dr William Gregory was carrying on his researches on Diatoms, Dr Greville aided him much, and delineated the forms which were published in the Transactions of the Royal Society of Edinburgh, in illustration of Gregory's paper. Dr Greville also drew the large figures which were exhibited to the Society, and which now constitute a part of the drawings belonging to the Botanical Class of the University.

A scientific friend, who used to dredge with Dr Greville on the west coast of Scotland, writes in regard to him as follows:—"I am surprised and grieved. Poor dear Greville! Oh, how truly do I mourn his departure from the midst of us! I feel that I have lost a friend whom I respected, valued, and loved. It is another link in the chain of my personal friends knocked off by the merciless hand of death. My thoughts run back to George Square, Dunoon, Holy Island, Goatfell, covering a space of no less than twenty-two years, during which I was intimately associated with him in dredging operations in almost every loch connected with the Clyde, as well as in deputation work in London and elsewhere. We have worked together heartily and affectionately in the field of natural history—he being my preceptor, and I his willing and thankful disciple. He and I have met together at a throne of grace, drawing all our comfort in the prospect of death and eternity from the fountain of mercy and of love. He is gone,—we must follow. Let us hold fast the profession of our faith—the confidence of our hope—την ὁμολογιαν τῆς 'ελπιδος—without wavering, for He is faithful that promised."

Dr Greville's attention was by no means confined to science. He was a man of high literary taste, and he took

a warm interest in all that concerned the wellbeing of his fellow-men. He was a thorough gentleman, a most agreeable companion, fond of music and of art, ready to enter into the enjoyments of youth, and to contribute to the pleasures of social intercourse. He was fond of the rod and the gun, like his valued friends the late James Wilson and Captain Grove, R.N., with both of whom he often enjoyed these country sports. In autumn last he had a season of shooting at Hunmanby, in Yorkshire, the residence of his old and kind friend Admiral Mitford. There was a taste, a neatness, and an order in all he did, which was quite remarkable. He touched nothing which he did not adorn. He prepared and dried plants admirably, and took great pleasure in garden pursuits; and the beauty of the arrangements at his villa at Murrayfield showed at once the hand of a man of science and of refinement.

Dr Greville took a prominent part in the agitation carried on for many years against slavery in our colonies. In 1833, when three hundred and fifty gentlemen assembled in London to represent to the Colonial Minister the sentiments of the country, he was one of the delegates from Edinburgh; and when a working committee (to sit in London), composed partly of the delegates and partly of members of the committee of the British and Foreign Anti-Slavery Society, was instituted, he was elected chairman; and he was one of the four vice-presidents of the great Anti-Slavery Convention of all Countries, held in London in 1840.

When the Temperance reform was first introduced into the country, he gave up a large portion of time to it for several years, and addressed innumerable meetings on the subject, besides using his pen largely in its support.

The Sabbath question was also taken up zealously by him, and he acted for four years as secretary of the Sabbath Alliance. He was always ready for every good and Christian work. The House of Refuge was an object of special interest, and he continued to the latest period of his life to attend the meetings of the directors of that institution. Societies for missions and for reformatory purposes, ragged schools, asylums for imbeciles and for the intemperate and the degraded, met with his warm sympathy and support.

He was also interested in municipal matters. He became a burgess of the city of Edinburgh in 1856, and he acted most conscientiously and assiduously for some years as a member of the Town Council.

He was a member of the English Church, but he was by no means sectarian in his views. He co-operated with all denominations of Christians in works of philanthropy and charity. His services could always be commanded for any effort which had for its aim the amelioration of the physical and spiritual condition of the poor and needy.

He was an earnest student of God's Word, and felt assured of the complete harmony between it and science. He was a true lover of nature, and pursued the study of God's works with zeal and success, so as to place himself on an undoubted eminence as a man of science, and as one of the first Cryptogamists of his day; and at the same time he was a humble believer in the plenary inspiration of the Bible, which he took as a lamp to his feet and a light to his path. In these days of scepticism among naturalists, he took a decided stand on the truth of Revelation.

In all the discussions as to man and his origin he firmly espoused the Scripture statement that man was created perfect in the image of God, and that he fell by yielding to the temptation of Satan; that thus his whole nature became corrupt, so that none can do good, no not one; and that it is only through the death and atonement of Christ, and faith in Him, that man can be restored. He was no supporter of man's progressive development from a simian to a human form, and from a low type of organisation, physically and morally, to a higher one. Man, in place of rising in the scale, has the tendency to fall; and, as Archbishop Whately remarked, in place of advance and elevation, we find in the natural man retrocession and degradation. Christianity can alone raise man from his fallen state. Dr Greville always upheld these views, and believed that, whatever may be said by geologists of human beings in remote ages, he felt satisfied that the man from whom he descended was the Adam of the Bible, whom God created at once complete and perfect as regards his physical, intellectual, and moral nature. True science has lost in Greville one of its ablest supporters, and the contenders for the faith once delivered

to the saints have to lament the departure of one of their noblest champions.

For some years Dr Greville suffered from occasional attacks of illness, but he was able to pursue his work with vigour, and walked regularly from his country villa to attend meetings in Edinburgh. He was very regular in his attendance at the Botanical Society.

His last illness commenced on 27th May, and was brought on by falling asleep on the damp grass. This gave rise to severe rigors, accompanied with inflammation of the lungs, from which he never fully rallied. He was attended by Dr Fowler of Corstorphine and by Dr Begbie. The symptoms did not seem alarming at first. On Tuesday, 29th, he wrote a note to me in pencil in reference to the death of a mutual friend—the Hon. Mrs Mackenzie. I had no idea that his illness was of a severe nature. On the evening of 1st June there was a great aggravation of the disease, and he sunk on the morning of the 4th, after suffering much from dyspnœa. He felt that he was dying, and gave various directions to a friend in attendance. He was ready for his change, and he died resting on the merits of his Redeemer. He was kept in perfect peace, stayed on Him who alone can comfort and support in the hour of trial.

His funeral took place on Friday the 8th June, and his mortal remains were deposited in the Dean Cemetery, not far from those of his friends Edward Forbes and James Wilson. The members of this Society met on the ground to pay the last tribute of respect to the memory of their amiable and highly-valued President. The mourners assembled in the house of the deceased, Ormelie Villa, Murrayfield, where the first part of the burial-service was read by the Rev. William Hogarth of Weymouth, his son-in-law. The pall-bearers were Mr Eden K. Greville, his son; Rev. Eden Greville, his brother; General Drummond, Rev. W. Hogarth, and Rev. Mr Williamson, his three sons-in-law; Mr D. R. Huie, nephew by marriage; Mr William Drummond, Professor Balfour, and Major Petley.

Such are a few of the prominent features in the character of our departed friend. We mourn his loss. We look back with melancholy interest to the many days we have

spent with him, and the many pleasant communications he has made to us. He has entered into his rest. "Blessed are the dead who die in the Lord: they rest from their labours, and their works do follow them."

II. *On the Flora of Lynn and the Vicinity. Part I.—Phanerogams and Ferns.* By Dr JOHN LOWE.

Compared with that of other counties, the Flora of Norfolk is one of great richness, both numerically and in point of rare species. The large list of species is no doubt, in some measure, due to the researches of those illustrious men whom the county has produced—I mean Sir James Smith, Sir W. J. Hooker, and Dr Lindley. The valuable list of flowering plants compiled for White's "History of Norfolk," by the Rev. G. Immford, comprises 1027 species and 40 varieties. This catalogue is still further extended in the more recent "Flora of Norfolk," by the Rev. R. Trimmer, one of the most complete county floras I have seen. To the above large number I have added upwards of thirty more, the Rubi and Salices being still very incomplete. The flora of the Lynn district, to which my remarks will be confined, embraces a very large proportion of this number. It is, moreover, very rich in Cryptogams, and its fauna is equally prolific. This may be attributed to its peculiar formation, which, including chalk hills, fen, moor, and sea-marshes, affords a habitat and sustenance to a great variety of animal and vegetable life. In the area under consideration—viz., about 18 miles from Lynn—we find that a line running nearly due north and south divides the marsh land on the west from the chalk on the east. In a line with the shore is an elevated plateau of chalk and lower greensand. Between this and the shore lie the salt-marshes. Inland are numerous unenclosed commons, but these are rapidly decreasing before the plough. In the west or marsh district there is no great abundance of *Plantæ rariores.* Some there are, however, worthy of notice. First among these may be mentioned the beautiful *Villarsia nymphæoides,* which grows luxuriantly in the Ouse near Hilgay, its elegant yellow flowers, dotted here and there amongst the floating leaves of equally elegant form, contrast well with

the more massive Nuphar which grows around. Like the Stratiotes, Hydrocharis, and Utricularias, I suspect the Hottonia is fast disappearing before the encroachments of its formidable foe, the Anacharis. For miles this pest may be met with reigning triumphant and alone, where formerly the more delicate aquatic plants were abundant. Almost the only group that can withstand its inroads seems to be the Charas. Of the aquatic Ranunculi, *R. floribundus*—the most attractive of the group, from its fine flowers and delicate odour—is of frequent occurrence. We find, also, *R. Drouetii*, *confusus*, and *circinatus;* the latter is, however, somewhat rare. *R. parviflorus* occurs in one or two localities; and *R. Lingua* is found sparingly in a few localities, but does not attain the great size which we find in the Lincolnshire fens, where it occurs often in immense beds, and having a height of five or six feet, its large and brilliant golden flowers and long spear-shaped leaves making it one of the finest indigenous plants.

Fringing the banks of the streams and ditches, *Lythrum Salicaria*, now rendered classic by the investigations of Mr Darwin, is everywhere conspicuous, with forests of *Butomus umbellatus*. *Nymphæa alba* is found in a few localities, but is not very plentiful. It occurs in Shouldham Fen, together with *Peucedanum palustre*, *Lysimachia vulgaris*, *Bidens tripartita*, *B. cernua*, *Lastrea Thelypteris*, *Utricularia minor* and *vulgaris*. In several places I have found *Veronica Buxbaumii* in profusion; and at St German's, *Alyssum calycinum*, which is new to West Norfolk. Potamogetons abound, but none of much variety, with the exception of *P. trichoides*, which I found at Terrington.

Turning now to the coast, we find in the immediate vicinity of Lynn the following plants:—*Rumex maritimus*, *Obione portulacoides*, *O. pedunculata*, *Suæda fruticosa*, *S. maritima*, *Chenopodium olidum*, the latter growing near houses at the north end of the town inhabited by the fishermen, a kind of locality which it usually affects. It would be interesting to know how far such plants as this owe their distribution or introduction to human agency. *Chenopodium Bonus-Henricus*, *Verbena officinalis*, *Anchusa sempervirens*, &c., are instances of a similar kind. *Lepigonum neglectum* is abundant on the shore; also *Artemisia maritima*, *A.*

gallica, *Ruppia maritima*, *Statice Limonium*, and *Œnanthe crocata*, the latter occurring only in one or two places in small quantity. In waste places near the town we have *Chenopodium polyspermum*, *Mercurialis annua* and *ambigua*, *Cheiranthus Cheiri*, *Lepidium ruderale*, *Diplotaxis tenuifolia*, *D. muralis*, *Parietaria diffusa*, *Lepturus incurvatus* var. *filiformis*, *Sclerochloa loliacea*, *S. maritima*, *Hordeum maritimum*. *Erysimum cheiranthoides* appears to have thoroughly established itself in this part of the country, growing on walls and waste ground everywhere. In the autumn it occurs in such profusion in turnip fields as often almost to hide the original crop; it is evidently very difficult to eradicate.

Some years ago I found on the banks of the Ouse *Setaria glauca*, which was first discovered by Mr Borrer at Waybridge. It is, of course, only a chance visitor. *Myosurus minimus* was formerly found on Hardwicke Common, but has now disappeared before a stronger vegetation. It is said to be found in one or two other places, but I have not yet met with it. *Trifolium subterraneum* also occurs on Hardwicke Common; and in fields near the same place *Orobanche minor* is very abundant. A few years ago I saw a clover field so completely covered with it, that most of the clover was killed. *Epilobium angustifolium* var. *brachycarpum*, which grows apparently quite wild on Bawsey Common, has not previously been recorded as a Norfolk plant. Here, also, I have found *Calamagrostis lanceolata* and *Digitalis purpurea*; and at Ashwicken, a neighbouring village, *Cladium Mariscus*, *Antirrhinum Orontium*, *Torilis infesta*, *Cichorium Intybus*, and *Stachys arvensis*; and very recently *Lepidium Draba* and *Doronicum Pardalianches* have been found near this place, the former being new to Norfolk, and the latter to West Norfolk.

Turning now in a direction N.E. from Lynn, we come to a good botanising ground at North Wootton, Castle Rising, Roydon. At the former place we find *Lathyrus palustris* in small quantity, *Lycopus europæus*, *Genista anglica*, *Jasione montana*, *Cuscuta Epithymum*, *Hypericum Elodes*, *Rhamnus Frangula*, *Schœnus nigricans*, *Juncus acutus*, *J. maritimus*, *Habenaria bifolia*, *Solidago cambrica*, *Teesdalia nudicaulis*. At Rising, *Potentilla argentea* occurs sparingly, and *Chrysosplenium alternifolium* and *oppositifolium*

are found growing together. On the earthworks around the fine old ruins of the castle, in which it is said Queen Isabella spent her last days as a captive, *Mœnchia erecta*, *Alsine tenuifolia*, and *Verbascum nigrum* var. *tomentosum*, occur. On Roydon Common, a short distance from the last-mentioned place, we have a rich treat in finding *Pyrola rotundifolia*, one of our rarest and most lovely plants. Here, too, we have *Rhynchospora alba*, *Medicago minima*, *Carex remota*, and *Festuca uniglumis*. *Aceras anthropophora* is said to grow here, but I have not yet been fortunate enough to find it.

Continuing the route at a little distance from the coast to Sandringham, the residence of H.R.H. the Prince of Wales, we arrive at good botanising ground, where, in their respective seasons, we may find *Rosa tomentosa*, a rare plant in this district, *Orchis incarnata*, *Carex Pseudo-cyperus*, *Cardamine amara*, and the exquisite little *Adoxa*; also, *Scleranthus perennis*, *Silene conica*, and the beautiful *Tillæa muscosa*, the latter occurring in great profusion on all waste sandy ground, in large patches of a blood-red colour. *Polygonum minus* is also abundant, and *Scirpus pauciflorus*; *Gymnadenia conopsea*, a plant by no means common in this county, occurs sparingly at this place. *Lathyrus macrorhizus* and *Euphorbia Lathyris* are both said to grow here, but I have not seen them; also *Caltha radicans*, but of this only one specimen was found by Mr J. E. Moxon (Botanical Guide), and this was probably only the var. β of *C. palustris*. *Botrychium Lunaria* was found here last year; and as this is the only recorded locality for it in West Norfolk, I regret to see that the station is being destroyed by improvements which are now being made on the Prince's estate.* *Lastrea cristata*, which was very abundant, is undergoing extinction from a different cause,—viz., the depredations of collectors and vendors of ferns, who come down and carry it off wholesale. *L. Oreopteris* occurs here sparingly, and, like the Botrychium, is of very diminutive habit, as if it had got somewhat beyond its natural geographical limit.

In Wolferton Wood, which is also on His Royal High-

* Since the above was written, another station has been found at Rising.

ness's estate, *Convallaria majalis* grows profusely, covering several acres of ground. *Endymion nutans* is equally abundant; the only station in the district for *Melica uniflora* is in this wood, where we also find *Lysimachia nemorum.* Adjoining is a tract of marshy ground, called Cranberry Fen, in which the *Vaccinium oxycoccus* grows in such profusion as I have never seen equalled, the greater portion of the bog being densely carpeted with the lovely flowers, followed by a rich harvest of berries, which are gathered by the villagers and sold at high prices. They find no difficulty in obtaining for the finer samples as much as 1s. per pint, so highly are they esteemed. A little farther, at Ingoldsthorpe, *Ophioglossum vulgatum* is found by the side of one of the creeks, from which the sea is now shut out; and *Lastrea Thelypteris* is so abundant as to form by the interlacing of the rhizomes a perfect carpet, capable of bearing one's weight over a deep morass. At the next village, Snettisham, we come to a wood which is, in the spring, most brilliantly decked with floral beauties. Over an extent of some acres the ground is covered with *Narcissus Pseudo-Narcissus*, and immense patches of blue and white *Vinca minor* and *V. major*, *Primula vulgaris*, and *Viola odorata* and *sylvatica*. A little later, *Narcissus poeticus* is most abundant, and later still *Hypericum Androsæmum.* On the chalk hills we find *Verbascum floccosum* in great beauty, and *Ophrys apifera.*

Passing on a few miles farther, we arrive at Hunstanton, a rapidly increasing watering-place, to which the Geological and Botanical Sections of the British Association made an excursion in 1862. I had intended at the time to have sent to the Society some notice of the botanical part of this excursion, but was prevented from so doing by a variety of engagements. I will briefly do so now.

Leaving the geological section under the guidance of Professor Phillips, employed with their hammers in exploring the fine chalk cliffs, and especially absorbed in the splendid section of red chalk, with its rare and interesting fossils, the botanical party—comprising Professors Balfour and Babington, Messrs Staunton, Newbold, &c., with myself in the character of guide to the locality—proceeded on its voyage of discovery. Though late in the season, we soon

met with some interesting plants in the fields at Hunstanton St Edmund's, Professor Babington almost immediately pointing out the then new *Arenaria leptoclados* and *Filago spathulata*, new to Norfolk. *Fœniculum officinale* was found in great profusion, and evidently quite naturalised. *Salvia verbenaca* and *Calamintha Acinos* were very abundant. On our way to Holme we gathered *Rumex pulcher*, *Lactuca virosa*, *Helminthia hieracioides*, *Lepidium ruderale*, *Cochlearia danica*, *Ranunculus hirsutus*, and *Geranium columbinum*. In Holme Marsh we met with the rare *Statice caspia;* had we gone a little farther we should have found it, as I have since done, in great profusion, the ground densely covered with the lilac flower, and associated with it the exquisite *Frankenia lævis*, whose delicate pink blossoms clothing the slender prostrate stems form a perfect floral mat. We also found *Statice Limonium*, *Sagina maritima*, *Erythræa pulchella*, *Saponaria officinalis*, *Samolus Valerandi*, *Carlina vulgaris*, *Glaux maritima*, *Leontodon erythrospermum*, *Carex fulva*, *Juncus maritimus*, *J. balticus*, *J. Gerardi*, *Chenopodium botryoides*, *Scrophularia aquatica*.

Blymus compressus was picked by Professor Balfour, and *Scirpus Savii* by myself, both being new to Norfolk.

Nearly opposite this point of the coast there is seen at extreme low water an extensive submerged forest, many large trunks of trees being visible at once. The sands were, in fact, some years ago quite covered by them. They are probably coeval with a bed of peat which underlies the greater part of the Norfolk estuary as well as the town of Lynn, and which is not improbably continuous with the great peat formation which extends into Cambridgeshire. The same kinds of fossil remains which are so abundant in the latter—viz., those of the red deer *(Bos primogenus)*, roe deer, &c.—are also found underlying Lynn, and are frequently washed ashore from the submerged forests beyond Hunstanton.

But to return to our excursion. On our way back to Hunstanton, along the shore, we found *Eryngium maritimum*, *Elymus arenarius*, *Convolvulus Soldanella*, *Suæda maritima;* and on the cliffs *Phleum arenarium*, *Bupleurum tenuissimum*, *Smyrnium Olusatrum*, and *Linum perenne*. A good dinner at the Royal Hotel, where we arrived some-

what too late to join the geologists in their exploration of the comestibles, concluded a very pleasant and memorable ramble.

Had the time of year been more favourable, we should have added to our list—*Glaucium luteum*, *Borago officinalis*, *Euphorbia exigua*, *Spiranthes autumnalis*, *Herminium Monorchis*, *Papaver setigerum*.

I have now briefly to notice a few more of the rarer plants of our vicinity.

At the famous ruins of Castle Acre we find *Galium tricorne*, *Calamintha Nepeta*, *C. Clinopodium*, and *Sedum reflexum ;* at Narboro', *Silene Otites*, *Herniaria glabra*, *Geranium lucidum*, which is said to have been introduced by Mr Crowe; if so it must have spread greatly, as Mr Bray informs me it now extends along one roadside for a distance of five miles; also, *Lactuca muralis* and *Aceras anthropophora*. At Shouldham *Orchis ustulata* is said to be found; and at Stoke, *Geranium pyrenaicum*, a rare Norfolk plant, is tolerably abundant.

In this brief and imperfect sketch of the botany of West Norfolk, I have merely noticed more prominently those localities which I have myself explored, and many plants of interest are omitted because I have not yet met with them. I hope, however, to have conveyed some faint idea of the kind of flora which we possess.

At a future time I trust I may be able to lay before the Society some observations on the Cryptogamic vegetation of this district, which has hitherto been very little examined.

Dr Balfour noticed the discovery of *Lepidium Draba*, near Burntisland, by Mr James G. Black, and exhibited specimens. He also noticed the discovery of *Gagea lutea* on the banks of the river Almond, in Perthshire, by the Rev. J. M. Bradshaw, M.A., and exhibited specimens.

Mr M'Nab placed on the table a small case of plants, just received from Dr Mueller, of the Botanic Garden, Melbourne, and brought home by Dr H. Madden. This case contained seven species of plants, viz., *Poa ramigera*, *Selliera radicans*, *Wittsteinia vacciniacea*, *Goodenia amplexans*, *Mniarum biflorum*, *Eurybia Traversii*, and *Mesembryanthemum australe*, all established in pots previous to being sent away.

It is rarely that we see comparatively soft-wooded plants brought home in such good condition, and in so simple a manner. The case was 105 days on the voyage, and the plants only once received water, but had occasionally sprinklings of fresh water over the cotton covering. This amateur case, which is easily lifted with one hand, was kept on deck during the voyage, and so placed that no salt water could reach it. It is thus constructed,—a rough unplaned old box, 13 inches long, 11 inches broad, and 6 inches deep; has two upright pieces of wood, 16 inches long and 2 inches broad, nailed, one in the centre of each end of the box, and a piece the same breadth and thickness nailed across the top, giving it a ridge appearance, over which a piece of thick unbleached cotton is stretched, and firmly tacked down. The ends are likewise covered with the same material. It is certainly a great improvement on the old cumbrous earth cases, requiring two or more men to lift them. From the great success and simplicity of the case now brought home, costing not more than 1s. or 1s. 6d. altogether, it will be found a great benefit to amateurs wishing to take out or bring home a few choice plants. The pots containing the plants fill the box, and are kept from moving by having a little damp moss introduced between them, and also over the surface of the pots. In the ordinary Wardian cases, which are usually filled with soil, the plants are turned out of pots and planted in the earth, often only a few days before being sent away. In such instances no new roots can be formed. This would require a period of three or four weeks, whereas in the case of well-established plants sent in pots, a few hours' notice previous to removal is all that is required. The light which the cotton allows to penetrate, and the air which reaches the plants through its fine meshes, seems to be more favourable for the preservation of delicate or soft-wooded plants, both as regards colour and substance, than the ordinary heavy air-tight glazed Wardian cases, which not unfrequently prove injurious to tender plants, by causing them to become pale and much drawn up. Such earth cases are very beneficial for all hard-wood plants, if previously established in them, and should be employed when the transmission of plants on a large scale is required; but for amateurs wishing to convey

one or two pet plants, the small cotton-covered case will be found the most profitable.

Growing specimens of *Cyclanthera explodens* were exhibited, and a specimen of *Tetragonolobus purpureus*, sent by Mr Stables, grown from seeds collected in Algeria by Lady Dunbar of Duffus.

Mr Gilbert Stuart exhibited large oak galls, and a monstrous form of *Geum rivale*, collected near Melrose.

Dr Alexander Dickson exhibited specimens of various forms of the British species of Geum.

Mr J. F. Robson presented specimens of *Schistostega osmundacea*, collected on the Overton Hills, Cheshire.

12*th July* 1866.—Dr Alexander Dickson, Vice-President, in the Chair.

The following Donations to the Library were laid on the table:—

Miscellaneous Botanical Works of Mr Robert Brown, D.C.L., F.R.S., vol. i.—From the Editor (J. J. Bennett, Esq.)

Mémoire sur la Famille des Pipéracées, par M. Casimir de Candolle—From the Author.

Congrés International de Botanique, Londres, Mai 22–25, 1866, Discours du Président—From the Author.

Le Specie dei Cotoni descritte da Filippo Parlatore—From the Author.

Palmae Pinnatae Tertiariae Agri Veneti, a Roberto de Visiani —From the Author.

Plantae Serbicae Rariores aut Novae, a Prof. Roberto de Visiani et Prof. Josepho Pancie, decas i.–ii.—From the Authors.

The following Donations to the University Herbarium were announced:—

From George Cunningham, Esq., C.E., per Allen Moncreiffe, Esq.—Five large boxes of Dried Plants, collected by the late Dr David Ritchie in India.

From Dr Alex. Christison—Parcel of Indian Plants, and specimens of the fruit of *Martynia diandra*.

Dr Grierson of Thornhill sent to the Museum a section of larch which was cut from a tree that grew at Shaws, in the parish of Closeburn, Dumfriesshire, which was understood to be one of the first planted larches in this district. The situation in which the tree grew was in the sheltered valley of the Nith, on a deep loam soil, the deposit of the river, at about 130 feet above the level of the sea. Decay had begun, and in consequence the tree was cut about four years ago. The section was cut at 13 feet from the ground. At the time it was cut, the workmen were unable to procure a saw of sufficient length to make a section at the root end, which would have had a diameter of about 15 inches more, that is, at above the swell of the root. There are from 120 to 130 rings of growth.

Professor Balfour noticed the death of Mr William Grant Milne, an Associate of the Society, which took place at Old Calabar on 3d May last. Mr Milne was originally connected with the Edinburgh Botanic Garden, where he did his work so zealously and well that Dr Balfour recommended him for an appointment under Captain Denham, who visited the Fiji and other islands in the South Sea. He made a valuable collection of plants, and a genus *Milnea* was named after him by Sir William Hooker. He afterwards returned to Edinburgh, and then went to the Glasgow Botanic Garden. Mr Clark, the curator, interested himself in him, and as he expressed a wish to go abroad, he got him appointed to visit Old Calabar, raising funds for the purpose, and securing a free passage for him. He made extensive explorations in that inhospitable country, and he sent home specimens of living and dried plants. His life was several times in danger from hostile tribes and from attacks of fever. In spite of all these adverse circumstances he persevered in his work. From time to time he sent home reports of his proceedings, several of which have been read at meetings of the Botanical Society. He explored the Qua Mountain, visited the Gaboon River district, and then went to Fernando Po, where he pitched his camp on a mountain 6000 or 7000 feet above the level of the sea. An attack of fever prostrated him there, and he was removed as soon as possible to Old Calabar. After this he visited the Cameroon Mountains. During his explorations there he was attacked with dysen-

tery. Again he was removed to Calabar, where he ultimately died. He was a bold and intrepid traveller, and he often exposed himself to danger in the pursuit of botany. He has fallen a victim to the unhealthy climate of Africa.

The following Communications were read:—

I. *On the Staminal Arrangements in some species of* Potentilla *and in* Nuttallia cerasiformis. By ALEXANDER DICKSON, M.D., Edin. (Plate VII.)

On examining, about a year ago, the flowers of *Potentilla fruticosa*, I was much struck with the disposition of the stamens. These are arranged in strongly-curved lines or festoons, each containing four or five stamens, and extending from petal to petal. The convexity of each festoon is towards the centre of the flower, and there are no stamens superposed to the petals. I have since then examined the development of this andrœcium, and, as might have been anticipated from the analogy of the rosaceous developments already observed, I find that in each festoon the two stamens next the adjacent petals are the first developed; the two or three forming the middle or lower part of the festoon appearing subsequently. It is very difficult exactly to observe whether or not the central stamen of the festoon, when this consists of five stamens, is actually younger than those on either side of it. I have not been able with certainty to detect any decided difference of size between them; and the absence of the middle stamen at a given time does not afford any sure proof of its being a later development, as it not unfrequently never appears. Judging, however, from the analogy of the other *Rosaceæ*, it may be considered almost certain that the central stamen of the festoon is the youngest. When the stamens have all appeared, they, together with the "petals," form a pentagon of mammillæ surrounding the hemispherical termination of the floral axis. The petaline mammillæ form the angles of the pentagon, and are the oldest and largest; next in size and age are the stamens nearest the petals; and youngest

and smallest are the two or three stamens in the middle of the sides of the pentagon (Plate VII. fig. 5). I cannot but think that such an arrangement strongly confirms the doctrine of rosaceous andrœcia propounded in my paper on *Mentzelia*, &c. (Trans. Bot. Soc. viii. p. 288); as I am unable to conceive of any possible explanation of such a festooned arrangement of stamens, unless we view the andrœcium here as consisting of five compound and confluent stamens, the terminal lobe of each such stamen being developed as a petal, so-called. When there are five stamens in the festoon, the central stamen must be regarded as an interstaminal lobe, analogous to interpetiolar stipules—to the intersepaline lobes in some species of *Campanula*, in *Nemophila*, and in *Potentilla* itself (the so-called epicalyx), or to the interpetaline lobes of the corolla of *Soldanella*.*

I have not been able to examine any of the nearest allies of *Potentilla fruticosa*. *P. glabra* is grown in the Botanic Garden here, but has not flowered for some years. In *Potentilla rupestris*, however, I have found an andrœcium in all respects similar to that of *P. fruticosa;* and, from Lindley's description of the stamens of *P. arguta*, an ally of *P. rupestris*, as "*about* 25, *filaments inserted on the margin of a five-lobed glandular disk, which surrounds the base of the receptacle*" (Bot. Reg. n. 1379), I suspect that the same arrangement occurs there also.

In connection with the foregoing investigation, I have been led to examine the staminal arrangements in a considerable number of species of *Potentilla*, in all about twenty-nine. The staminal arrangements in these species may be reduced under three heads or types.

Type I., where there are 20 stamens (16 where the flower is 4-nary): one superposed to each sepal, one to each petal; and one on either side of each petal (Plate VII. fig. 1).

* The corolla of *Soldanella* presents ten lobes, alternately trifid and entire. The five trifid lobes are the petals; the five entire ones the interpetaline lobes. The petals, soon after their appearance, become connate, forming a gamopetalous corolla, with five entire lobes. Some time after this, the interpetaline lobes appear as projections of the margin of the corolla, in the centre of each interpetaline sinus; and lastly, the lateral lobes of the petals appear. The development here corresponds, of course, to a basifugal evolution of leaf-lobes, and differs in this respect from what occurs in the compound stamens of *Potentilla*, which would correspond to a basipetal one.

This is, apparently, by far the commonest arrangement in the genus, as indeed in the whole family *Rosaceæ.*

Type II., where there are 30 stamens. Differing from the last by having three stamens, instead of one, in front of each sepal (Plate VII. fig. 2). This occurs in the forms falling under *P. hirta* of De Candolle's "Prodromus."

Type III., where there are 25 stamens (arranged in five festoons, extending from petal to petal). Differing from Type II. chiefly in the absence of oppositipetalous stamens (Plate VII. fig. 3). This occurs in *P. fruticosa*, *P. rupestris*, and probably in several others.

I have found it convenient, for the purposes of description, to employ the term *parapetalous* for those stamens which occur one on either side of each petal; *antisepalous*, for the stamen or stamens in front of each sepal; and *antipetalous* for the stamen or stamens in front of each petal.

The following is a list of the species examined by me, named and numbered according to Lehman's "Revisio Potentillarum" (Nov. Act. Acad. xxiii. Suppl.). In determining some of the species I have had great difficulty, which will be understood by any one who has had to do with this most troublesome genus. The names to which I have affixed the mark (?) are to be looked upon as only *approximately* correct.

No. in Revisio Potentillarum.	Species.	Type of Andrœcium.
5	P. fruticosa, *L.*	III.
11	P. ambigua, *Jacquemont*	I.
13	P. tridentata, *Sol.*	I.
15	P. bifurca, L.	I.
28	P. sericea, *L.* (?)	I.
43	P. stolonifera, *Lehm.*	I.
53	P. rupestris, *L.*	III.
60	P. Pennsylvanica, *L.*	I.
67	P pedunculаris, *Don.*	I.
80	P. palustris, *Scopol.* (Com. palustre *L*).	I.
84	P. chrysantha, *Trev.* (?)	I.
90	P. Taurica, *Will.* (?)	II.
91	P. recta, *L.* β. pallida (?)	II.
92	P. hirta, *L.* (?)	II.

No. in Revisio Potentillarum.	Species.	Type of Andrœcium.
97	P. umbrosa, *Stev.*	I.
98	P. Nepalensis, *Hook.*	
103	P. Calabra, *Tenore*	
104	P. argentea, *L.*	
106	P. inclinata, *Vill.*	
111	P. tomentosa, *Ten.* (?)	
125	P. maculata, *Pourret* (P. alpestris, *Hall.*)	
128	P. opaca, *L.*	
147	P. alba, *L.*	
153	P. Fragariastrum, *Ehrh.*	
156	P. atrosanguinea, *Lodd.*	
158	P. elatior, *Schlecht.* (?)	
182	P. Tormentilla, *Sibth.*	
186	P. reptans, *L.*	
190	P. anserina, *L.*	

Of the species, in the foregoing list, with andrœcia falling under Type I., the following are those which exhibit a tendency to vary, either by multiplication or reduction in the number of stamens:—

A. Species exhibiting a tendency to multiplication in the number of stamens:—

P. bifurca, L. Two flowers were examined; one was normal, while in the other one of the antisepalous stamens was replaced by two slightly connected by their bases.

P. peduncularis, Don.

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.*	Antipetalous stamens.
5	10	1, 1, 1, 1, 1	1, 1, 1, 1, 1
2	10	1, 1, 1, 1, 1	1, 1, 1, 1, 2
1	10	1, 1, 1, 1, 2	1, 1, 1, 1, 1
1	10	1, 1, 1, 1, 2	1, 1, 1, 1, 2
1	10	1, 1, 2, 1, 2	1, 1, 1, 1, 2

* In this and the succeeding tables, wherever the number of antisepalous or antipetalous stamens is indicated by five figures, these five figures represent the number of stamens in front of the five sepals or five petals respectively, and are noted down consecutively, as they may be read off on looking round the flower.

P. Calabra, Tenore.

Number of Flowers examined.	Parapetalous stamens	Antisepalous stamens.	Antipetalous stamens.
5	10	1, 1, 1, 1, 1	1, 1, 1, 1, 1
2	10	1, 1, 1, 1, 2	1, 1, 1, 1, 1
1	10	1, 1, 1, 1, 1	1, 1, 1, 1, 2
1	10	1, 1, 1, 1, 2	1, 1, 1, 1, 0
1	10	1, 1, 1, 1, 2	1, 1, 1, 1, 2
1	10	1, 1, 2, 1, 0	1, 1, 2, 1, 2

P. inclinata, Vill. (var. *subseptenata ?*)

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
5	10	1, 1, 1, 1, 1	5
2	10	1, 1, 1, 1, 2	5
1	10	1, 1, ×, 1, 2	5
1	10	1, 1, 1, ×, 2	5
1	10	1, ×, 1, ×, ×	5
3	10	1, 1, 1, 2, 2	5
3	10	1, 1, 2, 2, 2	5
1	10	1, 2, 1, 2, 2	5
1	10	1, 1, 2, 1, 2	5

The mark × indicates a partial resolution of a stamen into two, the filament bearing two anthers.

It will be seen from the above that, while *P. peduncularis* and *P. Calabra* have a tendency to vary, both in the antisepalous and antipetalous stamens, *P. inclinata* varies only in the antisepalous ones. In the last-mentioned species, it is remarkable how frequently a partial or complete resolution of an antisepalous stamen into two takes place.

B. Species exhibiting a tendency to reduction in the number of stamens:—

P. sericea, L. (?).

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
5	10	5	5
5	10	5	4
1	10	5	3

P. maculata, Pourret (*P. alpestris*, Hall.)

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
2	10	2	4
1	10	5	3
1	10	4	3
1	10	4	2
2	10	4	1
1	10	5	1

P. opaca L. (*P. intermedia*, Nestler). Six flowers were examined; four were normal, while the other two each wanted one antipetalous stamen.

P. Fragariastrum, Ehrh. In this species a great number of flowers have the andrœcium reduced to the 10 parapetalous stamens. Of better-developed andrœcia, I have noted the following:—

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
2	10	5	4
1	10	5	3
1	10	5	1
3	10	5	0
2	10	4	0
1	10	2	0
1	10	1	0

P. elatior, Schlecht. (?)

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
2	10	5	5
4	10	5	3
1	10	5	2
1	10	5	0

It is to be observed that in these reductions in the number of stamens, the antipetalous evidently disappear more readily than the antisepalous ones. This is what might have been expected, as the antipetalous stamens are the younger.

Of the species falling under Type II., those which I have examined are all variable in the number of stamens; and the tendency is almost always towards a reduction in

the number. In a few flowers only is a tendency to multiplication of the antipetalous stamens to be observed. I have named with some hesitation the forms occurring in the Botanic Garden; but they certainly all come under *P. hirta* of De Candolle's "Prodromus."

P. Taurica, Willd. (?).

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
4	10	3, 3, 3, 3, 3	5
7	10	3, 3, 3, 3, 2	5
2	10	3, 3, 3, 2, 2	5
4	10	3, 3, 2, 3, 2	5
1	10	3, 3, 2, 2, 2	5
2	10	3, 2, 3, 2, 2	5
2	10	3, 2, 2, 2, 2	5

P. hirta. L. (?).

Number of Flowers examined.	Parapetalous stamens	Antisepalous stamens.	Antipetalous stamens.
1	10	3, 3, 3, 3, 3	1, 1, 1, 1, 1
3	10	3, 3, 3, 3, 2	1, 1, 1, 1, 1
2	10	3, 3, 3, 2, 2	1, 1, 1, 1, 1
1	10	3, 3, 2, 3, 2	1, 1, 1, 1, 2
1	10	3, 3, 2, 3, 1	1, 1, 1, 1, 2
1	10	3, 3, 2, 2, 2	1, 1, 1, 1, 1
1	10	3, 2, 3, 2, 2	1, 1, 1, 1, 1
5	10	3, 2, 2, 2, 2	1, 1, 1, 1, 1
1	10	3, 2, 2, 2, 2	1, 1, 1, 1, 2
3	10	2, 2, 2, 2, 2	1, 1, 1, 1, 1

P. recta, L. (?)

Number of Flowers examined.	Parapetalous stamens.	Antisepalous stamens.	Antipetalous stamens.
5	10	3, 3, 3, 3, 2	1, 1, 1, 1, 1
1	10	3, 3, 3, 3, 2	1, 1, 1, 1, 2
1	10	3, 3, 3, 2, 2	1, 1, 1, 1, 1
3	10	3, 3, 2, 2, 2	1, 1, 1, 1, 1
2	10	3, 3, 2, 2, 2	1, 1, 1, 1, 2
1	10	3, 2, 2, 3, 2	1, 1, 1, 1, 1
1	10	3, 2, 2, 2, 2	1, 1, 1, 1, 1

In both of the species which I have mentioned as exhibiting the third type of andrœcium, viz., *P. fruticosa* and *P. rupestris*, the number of stamens varies. In the festoons which the stamens form, however, *five* stamens occur with sufficient frequency to justify me in assuming 25 to be the typical number of stamens in each flower. In one flower of *P. fruticosa* I observed a stamen *superposed* to one of the petals. This deviation, which is evidently rare, is very interesting, as showing an approach to the other types.

P. fruticosa, L.

Number of Flowers examined.	Number of stamens in the festoons.
2	5, 5, 5, 5, 5
2	5, 5, 5, 5, 4
3	5, 5, 4, 5, 4
1	5, 5, 6, 4, 4
5*	5, 4, 5, 4, 4
2	5, 4, 4, 5, 3
3	5, 4, 4, 4, 4
1†	7, 4, 5, 4, 4

P. rupestris, L.

Number of Flowers examined.	Number of stamens in the festoons.
1	5, 5, 4, 5, 4
1	5, 5, 4, 5, 3
1	5, 5, 4, 4, 4
3	5, 4, 5, 4, 4
8	5, 4, 4, 4, 4
1	4, 4, 4, 4, 4

It would be rash to speculate as to the probable value of the staminal arrangement in distributing the species of *Potentilla* into natural groups. I scarcely anticipate that it will serve as a basis for primary division of the genus, although I have little doubt that it will be found of great importance as a means of establishing, or at least limiting, minor groups. In a genus so extensive as this, my present contribution towards a knowledge of the staminal arrangements can only be viewed as a nucleus round which

* In one of these five flowers a stamen occurred superposed to one of the petals, in addition to those in the festoons.

† The tip of the sepal to which the festoon with seven stamens was superposed was bifid.

the results of further investigation may be aggregated. I therefore hope that any who have opportunities of examining or discovering species in the fresh state will carefully note the disposition of the stamens.

In connection with the foregoing, I would call attention to the andrœcium of *Nuttallia cerasiformis*, which, as is known, consists of only 15 stamens, viz., 10 parapetalous and 5 antipetalous (Plate VII. fig. 4). Such an arrangement contrasts most interestingly with the types I have described. Thus, in *Nuttallia* there are no antisepalous stamens; in *P. fruticosa*, &c., there are no antipetalous stamens; while in *P. anserina*, &c., there are both antisepalous and antipetalous stamens. Adopting my theory of rosaceous andrœcia, there is no confluence of the lobes of the compound stamens in *Nuttallia*, *i.e.*, there are no interstaminal lobes.

In conclusion, I must express my obligations to Mr M'Nab, for his having kindly permitted me to make what use I required of the collection of *Potentillas* in the Botanic Garden, from which I obtained the greater number of the species which I have examined.

Explanation of Plate VII.

[In the diagrams the sepals are shaded. The so-called petals (apices of the compound stamens) are represented in black. The stamens are represented by black spots; their relative ages (determined by observation of development or by analogy) being indicated by the size of the spots,—the larger representing the older, the smaller the younger stamens.]

Fig. 1. Diagram representing the staminal arrangement in species of *Potentilla* falling under Type I. This figure is reproduced from my paper on the andrœcium of *Mentzalia*, &c. The antipetalous stamens are represented as the most internal; but in many *Potentillas* (in the adult state at least) they appear to be external to the antisepalous stamens.

Fig. 2. Diagram of arrangement in species of *Potentilla* falling under Type II.

„ 3. Diagram of arrangement in species of *Potentilla* falling under Type III.

„ 4. Diagram of arrangement in *Nuttallia cerasiformis*.

„ 5. Portion of young flower of *Potentilla fruticosa*; *ec*, parts of epicalyx; *s*, sepals; *p*, petals so-called. Between the petals festoons of staminal mammillæ extend. Of the two festoons represented, one contains five, the other four stamens.

II. *On the Structure and Affinities of* Lepidodendron *and* Calamites. By William Carruthers, F.L.S., Botanical Department, British Museum. (Plates VIII. and IX.)

The imperfect knowledge we have of fossil plants is the result of the fragmentary condition in which they occur. The deciduous leaves, ripe fruits, or broken branches that fell into streams, and were carried to sea or lake, had so many dangers to encounter, that only a very few of them ever reached the usual deposit where they would be preserved, and these few in such a decayed and fragmentary condition that it is often impossible to do more than make the most vague guesses at the nature of the vegetation to which they belonged. The occurrence of vegetable remains on the site where they grew, is extremely rare in all the formations which form the crust of the earth, except in the Coal Measures. The plants of this period might therefore be expected to be well known, especially as the beds containing vegetable remains, of carboniferous age, have been more exposed, because of their economic value, than those of any, or indeed of all the other formations put together. The peculiar nature of the vegetation, and perhaps the extreme humidity of the atmosphere, and the swampy localities in which the plants grew, have made the superabundant mass of vegetable remains as great a mystery as the scanty and fragmentary fossil plants of other periods. Except in the thin films of charcoal which occur in most coals, traces of structure are scarcely to be found in the coal itself, so thoroughly has the vegetable matter been converted into amorphous pulp before mineralisation took place, or so completely has it been metamorphosed subsequent to deposition. The plants themselves have all been so brittle, that when portions are preserved, as they are in immense quantity, especially in the roof shales, they are so fragmentary, that it is difficult to determine the various portions that belong to the same plant. The root is rarely connected with the stem, the stem with the branches, or the branches with the leaves or the fruit. As a result, all these parts have been often referred to different genera, and have received different names. With additional observations,

the means are, however, occasionally turning up, which enable us to reduce some of these genera, the establishment of which was absolutely necessary in the earlier days of palæontological botany. Thus to give an example:—the trees belonging to the same set as those which were found imbedded in the sandstones at Craigleith quarries have been constituted into the genus *Dadoxylon;* the pith forms the genus *Sternbergia*, and some fluted and constricted specimens have been referred to *Calamites.* The leaves were considered to be ferns, and named *Cyclopteris;* and the fruit was thought to belong to a palm, and received the name of *Trigonocarpon.* We have not seen evidence sufficient to convince us that all these are correctly referred to the same plant; but this is the opinion of some distinguished palæontologists, and it serves as a good illustration of the present satisfactory tendency of palæontological botany.

A similar multiplication of generic names encumbers the synonymy of the two genera *Lepidodendron* and *Calamites.*

Lepidodendron was a branching tree of considerable size. It is separated from the other genera of coal plants by the form and arrangement of the leaf-scars upon its stem. More than forty species have been recorded; but as the scars present different appearances on different portions of the same plant, no doubt more species have been established than the materials fairly warrant. But that they were numerous in species, and very numerous in individuals, any one who has even cursorily examined a coal pit, or the fossils in any public museum, must be convinced. They certainly contributed largely to the formation of coal.

The researches of Witham,* Lindley and Hutton,† Brongniart‡ and Binney,§ have made us acquainted with

* The Internal Structure of Fossil Vegetables, 1833.

† The Fossil Flora of Great Britain, 1831–1837.

‡ Observations sur la Structure interiéure du Sigillaria elegans, &c.—*Archives du Muséum*, 1839.

§ Geological Society's Journal, 1862; and Philosophical Transactions, 1865. Mr Binney, in these papers, gives most careful and elaborate drawings and descriptions of some fossils in his extensive collection. He refers them to the genus *Sigillaria*, because of their agreement in internal structure with Brongniart's *S. elegans;* but he cannot separate them by their external mark-

the stem. These published observations, together with the examination of some beautiful specimens in the collections of Robert Brown, now in the Botanical Department of the British Museum, and of Mr Alexander Bryson, enable me to give a somewhat complete description of its singular structure.

The axis of the stem cannot be considered as a true medulla or pith, inasmuch as it is composed not of simple cells, but of elongated utricles of various sizes, irregularly arranged, and having thin walls marked with scalariform bars (Plate IX. fig. 2.) These utricles, indeed, differ from the vascular tissue of the woody cylinder which surrounds them only in their length. The tissue of the woody cylinder consists of long scalariform vessels, which increase in size from the inner margin to the outer, this increase being sufficient to meet the requirements of the enlarged circumference, with the help of only a few additional series of vessels. As there is no true medullary cellular tissue in the axis, so there are no medullary rays passing through this cylinder. In radial sections an appearance is seen singularly resembling, to the naked eye, the "silver grain" produced in dicotyledonous woods by the medullary rays; but this arises from a very different cause. The diameter of the vessels is so great, that on a polished surface only the scalariform wall of the vessel, that lies on or near the surface, is exhibited; and when the upper wall of a vessel is cut away, the lower wall is often so deeply buried in the opaque substance, that the peculiar structure is obscured. In the case of sections prepared for microscopic examination, both surfaces of some vessels are often removed, and the scalariform markings on the lateral walls, or on any horizontal walls which by chance occupy a medial position between the polished surfaces, only are seen. This absence of the scalariform bars gives at first sight the appearance produced by medullary rays.

ings from *Lepidodendron selaginoides*, Lindl. and Hutt.; and as the only characters by which the two genera are distinguished are derived from the markings on the stem, we must consider *Sigillaria vascularis* as a true *Lepidodendron*. I am the more satisfied as to this, because I believe no essential difference exists, as has been hitherto maintained, between the stems of *Sigillaria* and *Lepidodendron*, or any of the other lepidendroid plants of the Coal Period. I cannot enter into this question here, but I shall take an early opportunity of publishing my views, and the reasons for maintaining them.

The continuous cylinder of scalariform vascular tissue appears to be penetrated by the vascular bundles which ultimately supply the leaves. These bundles apparently originate either in the scalariform tissue of the axis, or on the inner surface of the woody cylinder. They have been mistaken for, or misnamed, medullary rays.

The woody cylinder is surrounded by a great thickness of cellular tissue, which extends to the exterior of the stem, and is composed of three distinct and separable zones. The inner zone has never, as far as I know, been perfectly preserved in any specimen, yet traces of it sometimes may be seen; and it is rightly restored in Brongniart's drawing of *Lepidodendron Harcourtii*, in the "Archives du Muséum," vol. i. plate xxxi. Its absence in fossils is owing to its extremely delicate structure. The cells of the middle zone have thicker walls, and they have consequently frequently resisted decomposition before fossilisation made them permanent. In the outer zones the cells are very much lengthened, and have a smaller diameter. They nearly resemble true vascular tissue; but the progress of lengthening may easily be traced from the interior outwards; and no distinction can be drawn between the true cells, and the long and slender ones of the outer circumference. The cell-walls of all the three zones are without markings of any kind.

These three cellular zones are traversed by the vascular bundles which rise from the outside of the interior woody cylinder, if they do not actually pass through it, and pass to the leaves and branches. These bundles separate from the woody cylinder a long way below the point where they pass off into the leaf. At first their direction is almost parallel with the cylinder, slightly inclining outwards; they then incline more outwards; and as they approach the circumference of the stem, they resume their nearly ascending direction for some distance, until they finally pass out to the leaves which they support. Each bundle consists of scalariform vessels, very much finer than those of the woody cylinder, surrounded by elongated cells like those of the outer zone, and probably still further enclosed by a delicate parenchyma, which disappeared before it could be fossilised. The only evidence I have of the existence of this cellular

tissue is, that the bundles never fill the cavities in the parenchyma of the stem through which they pass. The bundles terminate in the points seen on the areoles of the stem, which are the scars of the leaves.

The woody cylinder is of different thicknesses in different stems, and appears to have increased with the growth of the tree. There is, however, no indication of interruption in the growth or of seasonal layers. Yet it cannot be conceived that the whole vascular cylinder arose and was developed at the same time. It is very probable that the zone of slender, and consequently rarely preserved cellular tissue which surrounded the woody cylinder, was analogous in its functions to the cambium layer of phanerogamous stems, like the similar layers in recent *Lycopodiaceæ*, described by Spring in his "Monographie de la Famille des Lycopodiacées" (page 294).

If we separate the different structures we have described in the axis into two series, the one series axial, and the other epidermal, we shall have the axis composed of scalariform utricles, the woody cylinder and the vascular bundles passing to the leaves belonging to the first series, and the two external zones of the vascular tissue to the second. The inner zone of cellular tissue, like the cambium layer, was most probably common to both series, the cells of the outer circumference being developed into the parenchyma of the epidermal series, while the vessels of the woody axis were produced from the cells of the inner series.

Stigmarioid roots have been determined to belong to *Lepidodendron* as well as to *Sigillaria*, and their whole structure supports this determination. I have satisfied myself that there is nothing that can be truly called a medullary ray in the woody cylinder of *Stigmaria*, but into the proof of this I will not now stay to enter. The base of the trunk was divided into a few principal roots, and these again divided dichotomously, but the ultimate divisions were never much attenuated. Throughout their whole course, and from every portion of their circumference, they gave off rootlets of considerable length, which, with the exception of a slender vascular bundle, were entirely composed of delicate hexagonal cells. They were articu-

lated to flagon-shaped bodies sunk in cavities, arranged in a quincuncial manner over the stem. The internal structure of the *Stigmaria* root corresponds to that of the trunk of *Lepidodendron.* The axis was composed of fusiform barred cells, and this was surrounded by a woody cylinder, which was certainly penetrated by the vascular bundles that supported the rootlets. Beyond the woody cylinder came a great thickness of cellular tissue, almost always destroyed, but probably agreeing in its structure with the three zones of the stem.

In speculating upon the conditions under which the forests of *Lepidodendron* flourished, it is most important to observe whatever is peculiar in those organs by which the plants were connected with the physical conditions around them. Geologists have too much overlooked such considerations in their deductions as to the physical phenomena of a period from the plants and animals that then existed. They have often taken for granted that the known conditions of the living species of a genus are true also of the fossil members of the same genus. In the want of other evidence, such an assumption may be cautiously employed; but unless its true value be accurately estimated, the greatest errors may arise, as they have in the past. For example, the systematic position of *Elephas primigenius* having been clearly established, the inference was thought legitimate that, as the modern representatives of the genus were confined to tropical or sub-tropical countries, the boreal regions must have enjoyed a similar climate when they were inhabited by these ancient elephants. It was, however, discovered that their skin was clothed with wool and long hair, and that, consequently, they were adapted to endure a cold climate. In plants, the structure of the fruit would in most cases teach nothing as to the temperature and humidity of the atmosphere in which, or the kind of soil upon which, the organism grew, though it would be of the first importance in determining systematic position. On the other hand, the root, the leaves, and the tissues of the plant, would be of only secondary importance in regard to systematic position, but of the highest value in determining physical condition. In regard to *Lepidodendron*, its singular roots would seem to imply that it derived a large amount of moisture through

them from a moist soil, and so far differed from most living cryptogamia, which obtain it mostly from the atmosphere. The roots of this genus presented in their crowded and long rootlets an immense surface for the absorption of moisture; and in their great abundance of lax cellular tissue possessed the means of containing this moisture, and transmitting it to the foliage.

The leaves of *Lepidodendron* were simple, lanceolate, acute, and sessile. They had a single medial nerve. The younger branches were densely covered with leaves; and the scars left on the trunk after they perished give the numerous beautiful markings by which the species have been distinguished. The leaves, when found separated from the branches, are called *Lepidophylla.*

The fruit was a strobilus (Plate IX. fig. 3), formed from a shortened branch, the leaves of which are converted into scales, that support on their upper surface a single large sporangium (*Lepidostrobus*, Plate IX. fig. 4), or perhaps several small ones (*Flemingites*, Plate IX. fig. 6). There appear to be both macrospores (Plate IX. fig 5), and microspores in the same sporangium. I have examined at length the structure and affinities of these fruits, in a paper published in the "Geological Magazine," vol. ii. p. 433, to which I must refer, without here dwelling further on the subject. *Flemingites*, although the sporangia are enormously abundant in some coals, have not yet been found connected with any fossil; but specimens of *Lepidostrobus*, attached to branches of *Lepidodendron*, have been described by Dr Paterson in the Transactions of this Society, by Brongniart, and others; and I have noticed one fine specimen in the Museum of the Botanic Gardens here.

In tracing the affinities of *Lepidodendron*, we have the safest guide in the organs of fructification, and fortunately these have been satisfactorily determined. The sporiferous strobilus shows that it is a true cryptogam; and in general appearance and arrangement of parts, the strobilus can scarcely be distinguished from that of some living *Lycopodia*, except in the great difference of size; this affinity is strengthened by the character of the leaves, and the structure of the stem. But the possession of both kinds

of spores in the same sporangium exhibits stronger affinity to *Rhizocarpeæ* than to *Lycopodiaceæ*.

The structure of the arboreal stem of *Lepidodendron* is much more complex than that of any known cryptogam. The central axis of irregularly arranged vascular tissue in *Lycopodium* is suited to the low stature of the plants of that genus; but in the giant *Lepidodendron* there is a complexity, which approaches the structure of some dicotyledonous stems. The general arrangement of the tissues, resembling what exists in some *Cycadeæ* and *Cactaceæ*, has caused this fossil plant to be referred sometimes to the one, and sometimes to the other of these Orders; but the resemblance is only one of analogy, and not of affinity. The presence of scalariform tissue, of which the woody portion is entirely composed, and the absence of medullary rays, would, even if the fruit were unknown, be sufficient to establish the cryptogamic nature of the plant. A comparison with the Cycadean stem may help us, by the resemblances and differences which will appear, better to understand the stem of *Lepidodendron*. The Cycads have all a large medulla, composed of large sized parenchyma; in some genera traversed by numerous vascular bundles, as in *Encephalartus*, and in others entirely cellular, as in *Cycas* and *Zamia*. This is surrounded by a single woody cylinder, or several, everywhere penetrated with medullary rays. Beyond this there is a considerable thickness of parenchyma, composed, in their inner portion, of cells whose length exceeds only slightly their breadth; these gradually lengthen, until they assume an appearance very like the external portion of *Lepidodendron*. This cortical parenchyma is traversed by the vascular bundles which supply the leaves. The two stems are evidently built upon the same plan; and were we to substitute scalariform tissue for the gymnospermatous woody tissue, and scalariform utricles for true medullary parenchyma, and finally exclude the medullary rays, the description of the Cycadean stem would apply to that of *Lepidodendron*. And it deserves special notice, that the surface of the Cycadean trunk is composed of the bases of the old leaves, together with the scales which in some species are interspersed among them, or alternate with them. The leaves do not disarticulate at

the circumference of the stem, but at some distance from it, leaving a short portion of the base persistent. The scars of the outer surface of the stem give a different impression from those presented when the persistent bases of the leaf-stalks are removed. Whoever is even a little familiar with coal fossils, is aware that there are two sets of scars on the stems of *Lepidodendron*—one superficial, the other internal. The fossils that present the first set are generally said to be "corticated" stems, and those exhibiting the others "decorticated." The "bark" is generally converted into a compact structureless coal, the outer surface of which has the one set of scars, and the inner surface the other. I believe this coal is produced by the external of the two epidermal series, and that the outer scars were truly superficial, while the inner were produced by the vessels which passed to the bases of the leaves. The two sets of scars in Cycadean stems are analogous structures; but in *Lepidodendron*, the layer which bears the scars on its two surfaces is a compact cylinder, while in the *Cycadeæ* there is no connecting tissue uniting the bases of the leaves; they are closely packed together, but quite free from each other. It is evident that in many respects the fossil stem had a striking analogy in the arrangement of its parts to that of the recent Cycads, while it was, however, a true Cryptogam; and if we now examine the slender stem of *Lycopodium*, we shall find, I believe, that Lepidodendron, though more highly developed, does not differ essentially from it.

Spring, in his "Monographie des Lycopodiacées" (p. 293), describes the stem of this order as composed of five parts: 1*st*, The woody axis; 2*d*, A layer of delicate cells; 3*d*, The liber; 4*th*, The herbaceous envelope; and, 5*th*, The epidermis.

The axis is composed of bundles of scalariform vessels, scattered through a very delicate cellular tissue, in a regular figure, which varies in the different species. This axis is surrounded by a layer of lax, delicate, cellular tissue, which Spring considers to be the channel through which the sap circulates, and the seat of growth in the stem—the inner portion being developed into wood vessels, and the outer into "liber." The "liber" is composed of elongated cells,

with thickened walls. Spring gives to it this name because of its analogy to the liber in dicotyledons. This layer is often so thin that it is difficult to detect. It is surrounded by a thick greenish layer, composed of large elongated cells, with thin walls; and this is covered with an epidermis, consisting of small cells, with thick walls. The vascular bundles pass through the various layers of cellular tissue, from the axis to the circumference.

The great difference between the stem of *Lepidodendron* and *Lycopodium* is the existence of a pseudo-medulla, and the arrangement of the vascular tissue as a solid cylinder in the fossil genus, compared with the central position and loose structure of the vascular tissue in the recent plant. In both the recent and fossil stems, the vascular tissues are surrounded by a zone of thin-walled cells, which has disappeared in all the dried specimens of *Lycopodium* I have examined, leaving the axis free, and which, as we have seen, is very rarely preserved in *Lepidodendron.*

Calamites.—Few fossils have been more misunderstood than the set of plants to which the name *Calamites* is given. One of the least errors regarding them was that which placed the stem upside down, and made the cylindrical roots its leaves. *Calamites* is rarely preserved so as to exhibit structure, being almost always converted into amorphous coal, and exhibiting an apparently furrowed and jointed stem, somewhat resembling the recent *Equisetaceæ.* The few specimens that have been found with the internal organisation of the stems preserved show a structure different from what had been assumed to be that of *Calamites*, and have been constituted into the genus *Calamodendron.* Like *Lepidodendron*, *Calamites* must have been a very brittle plant, as its remains occur in such a fragmentary condition, that great difficulty has been experienced in determining the different parts of the plant. The branchlets and foliage have been referred to the genus *Asterophyllites*, supposed to be independent aquatic plants, and the fruits form the genus *Volkmannia.*

The stem of *Calamites* was formed on a different plan from that of *Lepidodendron.* Mr Binney is at present engaged in preparing an account of its internal structure, with copious illustrations, which will be more complete than

any hitherto published, because of the abundance of well-preserved specimens contained in his cabinet, the result of so many years' devotion to the study of the fossils of the Coal Measures. I shall therefore content myself with a hasty sketch of the genus. The specimens hitherto figured by Petzholdt, Corda, Gœppert, Sternberg, Unger, and others, have generally wanted the cellular tissue of the axis and of the epidermis. The specimens which Mr Binney has shown me exhibit, as I believe, the whole structure from the centre to the circumference. The axis (Plate VIII.) consists of a considerable mass of cellular tissue without any vascular bundles penetrating it. This is surrounded by a solid cylinder of wood, formed entirely of scalariform vessels, and without (in all the specimens I have examined) any trace of medullary rays. The vascular tissue was developed from a series of equidistant points near the circumference of the cellular tissue, and grew outwards and laterally until they united in a continuous cylinder, fluted on the inner surface, and with flutings filled with the cellular tissue of the axis. The early vascular bundles in the young stems of exogenous plants have a similar origin, but they speedily unite to form a woody cylinder, with a clearly defined and smooth inner surface towards the pith. This early condition is permanent in the stem of some arborescent species of *Cactus*, which, in this respect, closely resembles *Calamites*; but it is only a similarity in the arrangement of the parts, without any true affinity, for the stems differ as much as *Lepidodendron* does from *Cycas*. The woody cylinder formed constrictions at regular intervals round the cellular axis, as in some recent *Artocarpeæ*. Beyond the woody cylinder there was a thin epidermal layer of parenchyma, which is less seldom preserved than even that of the interior.

The flutings and constrictions of the stem described as external were on the interior of the woody cylinder. The parenchyma having generally disappeared in fossilisation, the wood alone formed the thin layer of coal that is generally all that remains to indicate the existence of the fossil. This is always furrowed longitudinally, and barred at intervals, apparently externally; but the examination of specimens, in which the structure is preserved, show that

there was no fluting on the outer surface. Richter and Unger, in their "Palæontologie des Thüringer Waldes" (Vienna, 1856), have restored the stem of a calamite with a thick epidermal cellular layer, and this they have furrowed on its outer surface; but as this layer was so perishable that it has almost invariably disappeared, it could not have produced the furrows which occur in almost every specimen. When the stems were thrown down the cellular portions were generally completely decayed, and the space occupied by the axis was filled with the clay or sand in which the plant finally rested. In this way a cast of the interior was made, which, in time, became harder than the vascular tissue of the stem, and the pressure of the superincumbent deposits flattened and compressed the woody cylinder, producing on its upper surface a counterpart of the internal cast, with its furrows and constrictions. The furrows vary in size and closeness in different specimens, and produce indications sufficient to account for the different species that have been established.

The stem somewhat rapidly contracted at the base, the nodes shortening and giving off long cylindrical roots which spread laterally through the soil.

The main stem was simple, but at intervals gave off whorls of slender branches, and these again bore branches or leaves also arranged in whorls. The leaves were linear-acuminate, and each whorl contained from ten to twenty leaves.

The fruit (Plate IX. fig. 7) was composed of whorls of scales alternating with and protecting whorls of sporangium-bearing spines (Plate IX. fig. 9). It was borne either at the termination of the primary branches or in whorls around them, and was composed of a shortened axis, with the leaves specially developed. The strobilus described by Ludwig (Meyer's "Palæontographica" vol. x. p. 11, table ii.), consists of from twenty to twenty-five series of barren protecting scales, arranged fifteen in a whorl, the scales of each whorl being opposite to those in the others. Between the scales is a whorl of five short spines, each supporting four flask-shaped sporangia. The spines of one series are arranged opposite to the spines of the other, that is to say, they are arranged perpendicu-

larly on the axis, the one directly over the other. I have confirmed these observations on specimens of the fruits found in Britain, belonging to Dr Hooker, and made some important additional observations on the structure of the strobilus and the contents of the sporangia, which I hope soon to publish.

It is not easy to find anything analogous to *Calamites* among recent plants. Nevertheless its structure does not differ so essentially from the vascular cryptogams as to cause any uncertainty as to its position. The histological character of its wood, the absence of medullary rays, and the nature of its fruit, clearly establish that it was a true cryptogam, and while it differed in the arrangement of the parts of its stem in its foliar appendages, and in its organs of fructification from *Lepidodendron*, yet it is evident these were both near allies, and both more highly organised than any of their living representatives.

Explanation of Plates VIII. and IX.

Plate VIII.

Restoration of *Lepidodendron* and *Calamites*; and section of stem of *Calamites*, showing the position of the fluting. (The axis is drawn too slender in proportion to the thickness of the stem.)

Plate IX.

Figs. 1–5. *Lepidodendron.*—1. Transverse section of the half diameter.—2. Longitudinal section of ditto.—3. Strobilus.—4. Scale and Sporangium. The vascular bundle should be produced to the apex of the scales.—5. Spores.

Fig. 6. Scale of *Flemingites.*

Figs. 7–12. *Calamites* (after Ludwig).—7. Strobilus.—8. Part of a whorl of strobili.—9. Longitudinal section of two cells of a strobilus.—10. Transverse section of one cell.—11. Apex of a spine with its four sporangia.—12. Scales from strobilus.

III. *Account of a Botanical Excursion to Forteviot and Invermay, Perthshire, on 7th July.* By Mr John Sadler.

Mr Sadler gave an account of one of Professor Balfour's class excursions to Invermay, on Saturday 7th July, and enumerated the more interesting plants collected. The party, numbering about forty botanical students, and

accompanied by Professors Balfour and Liston, Dr Dickson, Dr Traquair, and the author, left Edinburgh by the morning train, and on reaching Forteviot, about nine o'clock, partook of breakfast in Mr Wood's Station Hotel there. Hence they proceeded by the banks of the May to the "Birks of Invermay," where they were met by Mr Brown Douglas, Dr Lauder Lindsay, and Dr Laing, of Bridge of Earn. They next visited that remarkable natural curiosity, the "Humble Bumble," so called from the peculiar noise made by the water, as it rushes through the narrow passage it has cut out for itself in the conglomerate sandstone rock; and Muckarsey Linn, a pretty little waterfall of about 30 feet. They returned by the old church of Muckarsey, which is now used as a burying-ground, with its ivy-clad walls and shelter of aged yew trees, to Invermay House, where they were joined by Sheriff Jameson, from Aberdeen, and where they were most hospitably entertained to lunch by Mr and Mrs Brown Douglas. The party returned to Edinburgh by train, passing Forteviot about half-past four P.M., all fully satisfied with their trip, the day being extremely fine. The following were amongst the plants collected:—

Cardamine amara.
Sinapis alba.
Cerastium arvense.
Hypericum humifusum.
  maculatum.
Malva moschata.
Geranium sylvaticum.
Astragalus Hypoglottis.
Trifolium medium.
  striatum.
Vicia sylvatica.
Geum intermedium.
Rubus saxatilis.
Galium Mollugo.
Campanula latifolia.
Melampyrum pratense.
Mimulus luteus.
Veronica montana.
Stachys Betonica.
Polygonum Bistorta.
Habenaria chlorantha.
Listera ovata.
Neottia Nidus-avis.
Lilium Martagon.
Holcus mollis.
Polystichum angulare.
Botrychium Lunaria.
Cystopteris fragilis (*large var.*)
Equisetum umbrosum.

Professor Balfour noticed some new localities for several rare plants in the neighbourhood of Edinburgh. Among others were the following:—*Scutellaria galericulata*, Dundas Hill; *Ceterach officinarum*, Renton; *Vicia Orobus*, Grant's House; *Chelidonium majus*, Culross; *Trifolium hybridum*, near Charleston; *Helosciadium inundatum*, near

Kincardine-on-Forth; *Botrychium Lunaria*, Dolphinton; *Carduus arvensis*, var. *setosus*, near Culross; *Corallorrhiza innata*, near Culross; *Eriophorum latifolium*, abundant at Dolphinton; *Omphalodes verna*, near Kirkliston; *Lilium Martagon*, Dalmeny; *Tulipa sylvestris*, Binny Crag (Mr Christie); *Hypnum nitens*, Dolphinton (Mr Sadler.)

Dr John Lowe recorded the discovery of *Lepidium Draba* in a naturalised state, near Lynn, Norfolk, by Mr B. Bray. He writes as follows:—"On the 30th May last, some fine specimens of this plant were brought to me by Mr B. Bray, a zealous botanist of this town. He had discovered them at Ashwicken, about four miles hence. As this species was new to Norfolk, I was anxious to ascertain how far it could be regarded as naturalised; and with this view, went over to inspect the locality, which I found to be along the side of a garden hedge at the farm-house of Ashwicken. It is apparently quite naturalised, and grows in great plenty. Through the kindness of the Rev. John Freeman, the rector of the parish, I am enabled to give the following notes upon it. He has observed it growing in its present habitat for many years past. It does not grow in the adjoining garden, the laying out and planting of which he himself superintended some eight or ten years since. The space upon which the Lepidium grows was previously waste ground, and there had not been a garden on the site within the memory of that oft-quoted individual, 'the oldest inhabitant.' Mr Bray tells me that he has observed it for several years. We may, therefore, I think, regard it as very fairly naturalised."

William Carruthers, Esq., noticed the discovery of *Wolffia arrhiza* in a pond at Staines, by H. Trimen, Esq. The plant is new to the British flora. Specimens were exhibited.

Dr Thomas Anderson, Calcutta, sent reports on the cultivation of *Cinchona* at Darjeeling, which were laid on the table.

Professor Balfour stated that Dr J. E. Gray notices, in a recent number of the "Journal of Botany," *Phyllactidium pulchellum* as a fresh-water alga new to the English flora.

This is not really the case. It may be new to England, but it was certainly found thirteen years ago in Scotland. Mr George Lawson (at that time his assistant, and now Professor of Botany in Dalhousie College, Halifax, Nova Scotia) collected it in the water of a vase at the Royal Botanic Garden in June 1853, and Professor Balfour exhibited under the microscope specimens put up at that time by Mr Lawson.

Mr M'Nab exhibited a number of seedlings raised from spores of the *Athyrium Filix-fœmina* var. *Victoriæ.* Very few of the plants raised presented the peculiar form of the parent variety, most of them assuming, more or less, the appearance of the ordinary crested variety. Many of them also approached the specific form. In connection also with this subject, he gave a statement of the proportions of crested forms procured from spores of the following varieties:—*Asplenium Trichomanes cristatum*, 100 per cent. true; *Lastrea Filix-mas cristata*, 95; *Athyrium Filix-fœmina cristatum*, 90; *Athyrium Filix-fœm. Frizelliæ*, 50; *Athyrium Filix-fœmina Victoriæ*, 25; *Blechnum boreale cristatum*, 75; *Blechnum boreale crassicaule*, 75.

Mr M'Nab exhibited a specimen of the wild strawberry (*Fragaria vesca*), which was picked in flower six weeks ago by Miss Gibson-Craig of Hermiston, for the purpose of making a drawing. The specimen was placed in a glass of water at a north window when only one bloom was expanded. It has recently produced a ripe strawberry, and others are rapidly coming forward.

Mr G. M. Lowe exhibited under the microscope some concretions taken from the intestines of a boy thirteen years of age. They seemed to be formed of fine hairs, which surround the grains of Indian corn, on which the boy had been subsisting.

Sir William Jardine, Bart., sent living specimens of *Orobanche major*, collected near Jardine Hall, Dumfries-shire, growing on the broom.

Simon Hutchison, Esq., Manthorpe Lodge, Grantham, sent a large living plant of *Inula Helenium.*

Sir William Jardine reported that in Galloway the tulip trees were flowering in several places. At Jardine Hall also these trees were showing abundance of flower-buds.

APPENDIX.

Patron:
HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS,

Corrected to November 1866.

HONORARY FELLOWS.

His Royal Highness The PRINCE of WALES, K.G., Hon. F.R.S.E.
His Royal Highness The DUKE of EDINBURGH, K.G., K.T., LL.D.

BRITISH SUBJECTS (limited to six).

Charles Cardale Babington, M.A., F.R.S, Professor of Botany, Cambridge
George Bentham, F.R.S., President of the Linnean Society
Charles Darwin, M.A., F.R.S., Down, Bromley, Kent.
Charles Giles Bridle Daubeny, LL.D., M.D., Professor of Botany, Oxford
Joseph Dalton Hooker, M.D., F.R.S., Director of the Royal Gardens, Kew

FOREIGN (limited to twenty-four).

Jakob Georg Agardh, Stockholm
Henri Baillon, M.D., Professor of Natural History to the Faculty of Medicine, Paris
Antonio Bertoloni, M.D., Professor of Botany, Bologna
Alexander Braun, Member of the Royal Academy of Sciences, Berlin ; Professor of Botany and Director of the Royal Botanic Garden, Berlin
Adolphe Theodore Brongniart, M.D., Professor of Botany at the Garden of Plants, Paris.
Alexander von Bunge, Professor of Botany, Dorpat
Alphonse de Candolle, Emeritus Professor of Botany, Geneva
Joseph Decaisne, Member of the Institute, Professor of Agriculture, Paris
Elias Fries, M.D., Professor of Rural Economy, Upsala
Heinrich Robert Goeppert, M.D., Director of the Botanic Garden, and Professor in the University of Breslau
Asa Gray, M.D., Professor of Natural History in Harvard University, Cambridge, Massachusetts
August Heinrich Rudolph Grisebach, Professor of Botany, Göttingen
Le Chevalier Giovanni Gussone, Director of the Royal Botanic Garden, Naples
Wilhelm Hofmeister, Professor of Botany and Director of the Botanic Garden at Heidelberg
Charles Martins, Professor of Natural History, and Director of the Botanic Garden, Montpellier
Carl Friedrich Philip von Martius, M.D., Director of the Royal Botanic Garden, Munich
Friedrich Anton Wilhelm Miquel, Professor of Botany, Utrecht
Hugo von Mohl, M.D., Corresponding Member of the Institute of Paris, Professor of Botany, Tubingen
Matthias Jacob Schleiden, Dresden
John Torrey, M.D., Professor of Botany and Chemistry, New York
Louis Rene Tulasne, Member of the Institute, and Botanical Assistant in the Museum of Natural History, Paris
Gustave Thuret, Member of the Institute, Paris
Franz Xavier Unger, M.D., Member of the Imperial Academy of Sciences, Vienna ; Professor of Botany, Vienna

RESIDENT FELLOWS.

(*Resident Fellows who have compounded for their Annual Subscriptions and Transactions, are marked with an asterisk *.*)

Allman, G. J., M.D., Prof. of Natural History
Anderson, Findlay, 32 Moray Place
Archer, T. C., F.R.S.E., Director of the Museum of Science and Art
Baddeley, John, 29 Frederick Street
*Balfour, John Hutton, M.D., Professor of Botany
*Ballantyne, John, jun., Dalkeith
*Barclay, Thomas, Sheriff-Clerk of Fife
*Bayley, George, 2 Bellevue Crescent
*Bell, J. M., 16 St Andrew Square
10 Blackie, J. S., Professor of Greek
*Brand, William, W.S., Northumberland Street
Brown, Robert, of Campster, 4 Gladstone Terrace
Browne, W. A. F., M.D., New Register House
Bryson, Alexander, 66 Princes Street
Buchan, Alexander, M.A., Sec. Met. Soc., 18 Fettes Row
Cairns, Thomas, M.D., 48 George Square
Christie, Alexander Craig, 4 Oxford Street
Christison, David, M.D., 40 Moray Place
Christison, Robert, M.D., Prof. Mat. Med.
20 Craig, Right Hon. Sir William Gibson, Bart.
*Colvin, Rev. R., Kirkpatrick-Juxta, Moffat
Cumming, James, 18 Ainslie Place
Dawson, John, Princes Street, Perth
Dickson, Alex., M.D., 11 Royal Circus
Dresser, Christopher, Ph.D., St Peters, Hammersmith
Duncan, John, 27 Dundas Street
Duncanson, John Kirk, 56 Cumberland Street
Falkner, Jas. P., S.S.C., 4 Bank Street
*Fraser, P. Neill, Canonmills Lodge
30 Fraser, Thomas R., M.D., Materia Medica Rooms, College
*Gainer, Charles, M.D., Oxford
Gamgee, Arthur, M.D., College
Goodsir, John, Professor of Anatomy
Gorrie, William, Agnes Cottage, Trinity
*Graham, Humphrey, W.S., 11 Shandwick Place
Hay, Samuel, Trinity Lodge
Henry, Isaac Anderson, Hay Lodge
Hossack, B. H., 1 South Charlotte Street
Hutchison, Robert, of Carlowrie, F.R.S.E., Kirkliston
40 Inglis, Andrew, M.D., 33 Albany Street
Inglis, Archibald, M.D., 33 Albany Street
Ivory, Thomas, 9 Ainslie Place
Ivory, William, W.S., 25 Castle Street
*Jardine, Sir William, Bart., F.R.S.
*Jenner, Chas., Easter Duddingston Lodge
Kerr, C. Webster, Ferry Road, Dundee
*Lawson, Charles, jun., 35 George Square
Lawson, G. S., 1 George IV. Bridge
Linton, John, M.D., 5 Roxburgh Street
50 Lowe, George May, M.B., M.C., Lincoln
Lowe, William Henry, M.D., Balgreen
Macadam, Stevenson, Ph.D., F.R.S.E.
Macbean, Robert
Macbeth, John S., M.A., M.B., M.C.
*Macfarlan, A. J., M.D., 4 Park Place
Mackintosh, R. T., Melbourne Place
Maclagan, Andrew Douglas, M.D., Professor of Medical Jurisprudence
Maclagan, R. Craig, M.D., 5 Coates Crescent
M'Laren, John, jun., advocate, 12 Darnaway Street
60 *M'Bain, J., M.D., R.N., Trinity Crescent
Macdonald, John, 6 Randolph Crescent
M'Nab, James, Royal Botanic Garden
Menzies, John, 31 Windsor Street
Naylor, F., 118 Princes Street
Nicol, George D., Arbroath
Nivison, T. R. S., M.D., Jersey
Panton, George A., Hope Terrace
Paterson, Andrew, land-steward, Arniston
Paton, J. Wilson, 8 Walker Street
70 Parnell, Richard, M.D., 7 James Place, Leith Links
Ravenscroft, Edw. J., 1 Geo. IV. Bridge
Ritchie, C. Currie, Nether Liberton House
Roberts, David W., 12 Salisbury Street
Robertson, P. S., Trinity Nursery
Robson, Thomas
Rutherford, William, M.D., 11 York Place
Sadler, Samuel C., 17 Meadow Place
Seller, William, M.D., 18 Northumberland Street
*Simpson, Sir J. Y., Bart, M.D., Professor of Midwifery
80 *Sprot, Thomas, W.S., 10 Drummond Place
Stark, Robert M., Trinity
Stuart, Gilbert C., 38 Cumberland Street
Taylor, Andrew
Thomson, Thomas, W.S., Thistle Court
Thomson, William, 15 Nelson Street
Thomson, Wm. Thomas, 3 George Street
Thomson, R. W., 3 Moray Place
Traill, Robert, Aberlady Lodge, Drem

Traquair, Ramsay H., M.D., Lect. Bot., Cirencester
90 *Walker, Arthur A., M.D., 32 Melville St.
White, F. B. W., M.D., Perth
Wilson, John, Professor of Agriculture
Yellowlees, David, M.D., County Asylum, Bridgend, Glamorganshire

NON-RESIDENT FELLOWS.

*Those who have compounded for their Transactions are marked with an asterisk **

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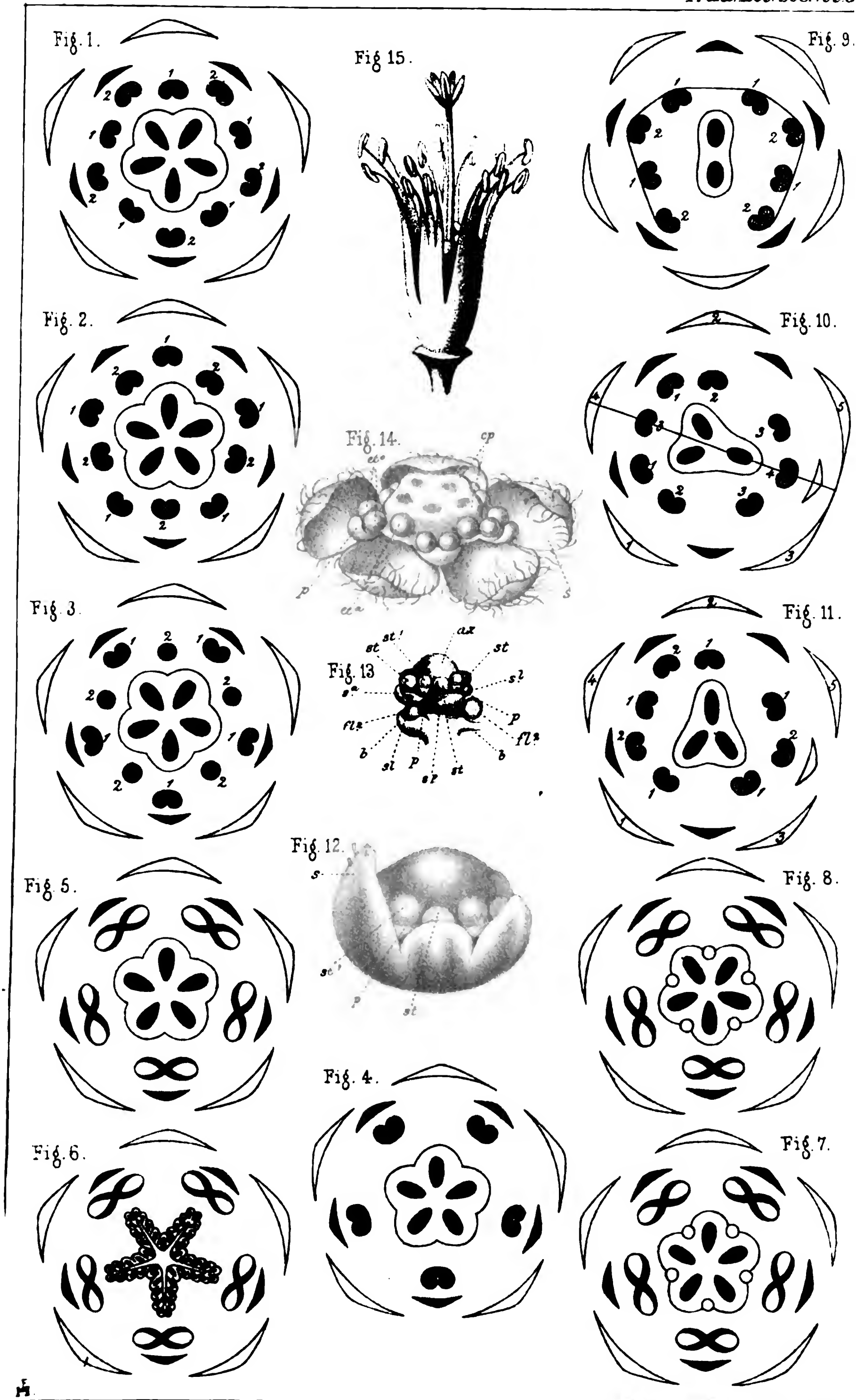

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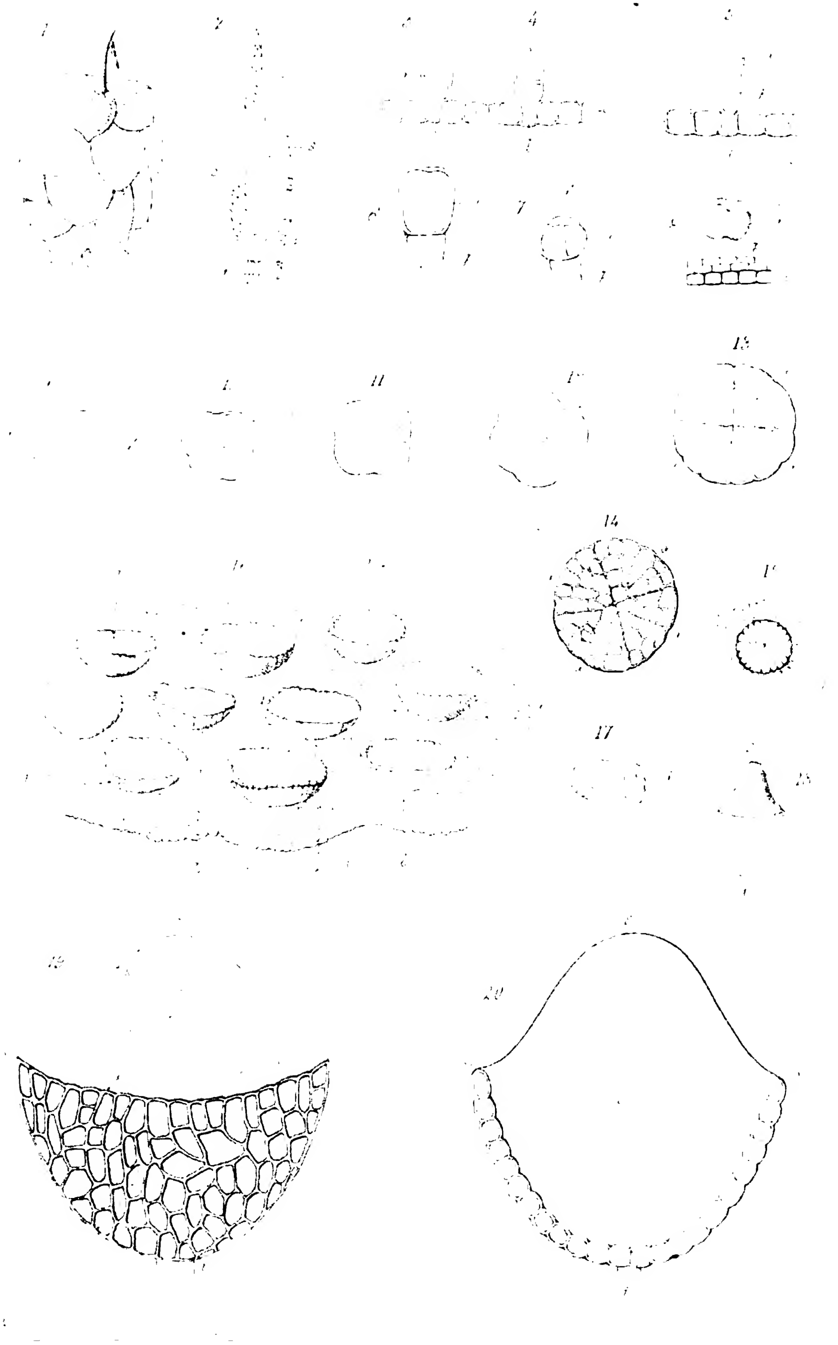

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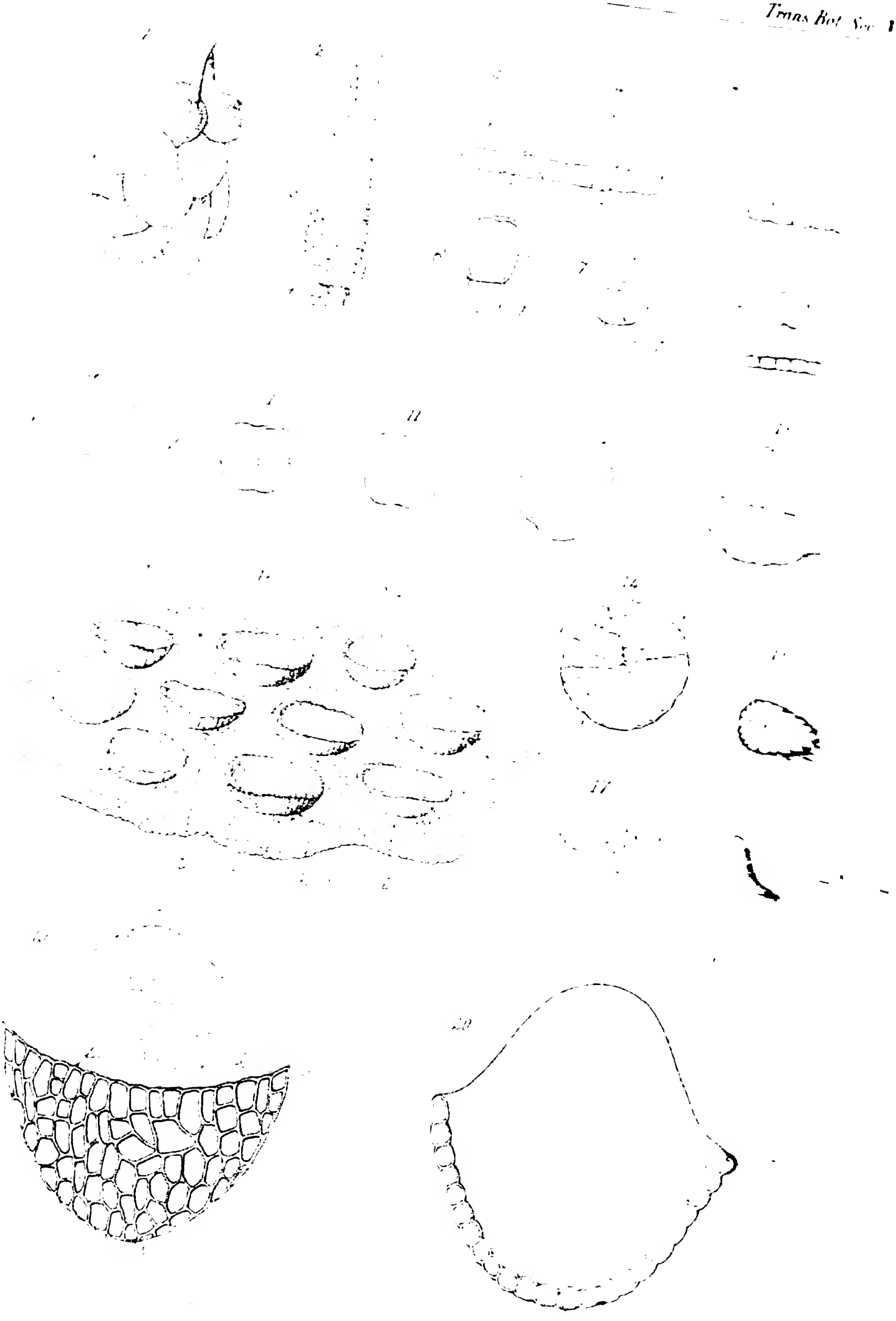

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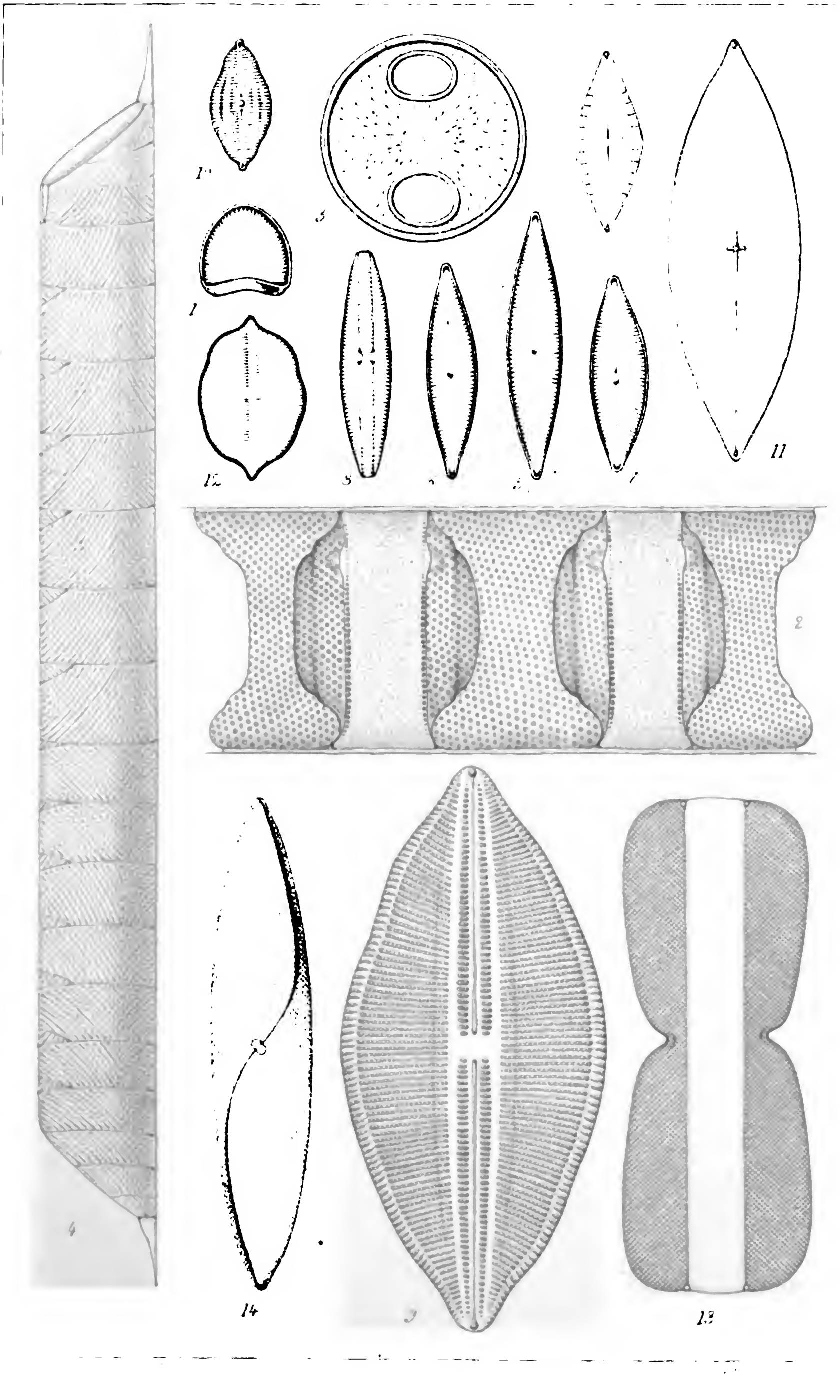
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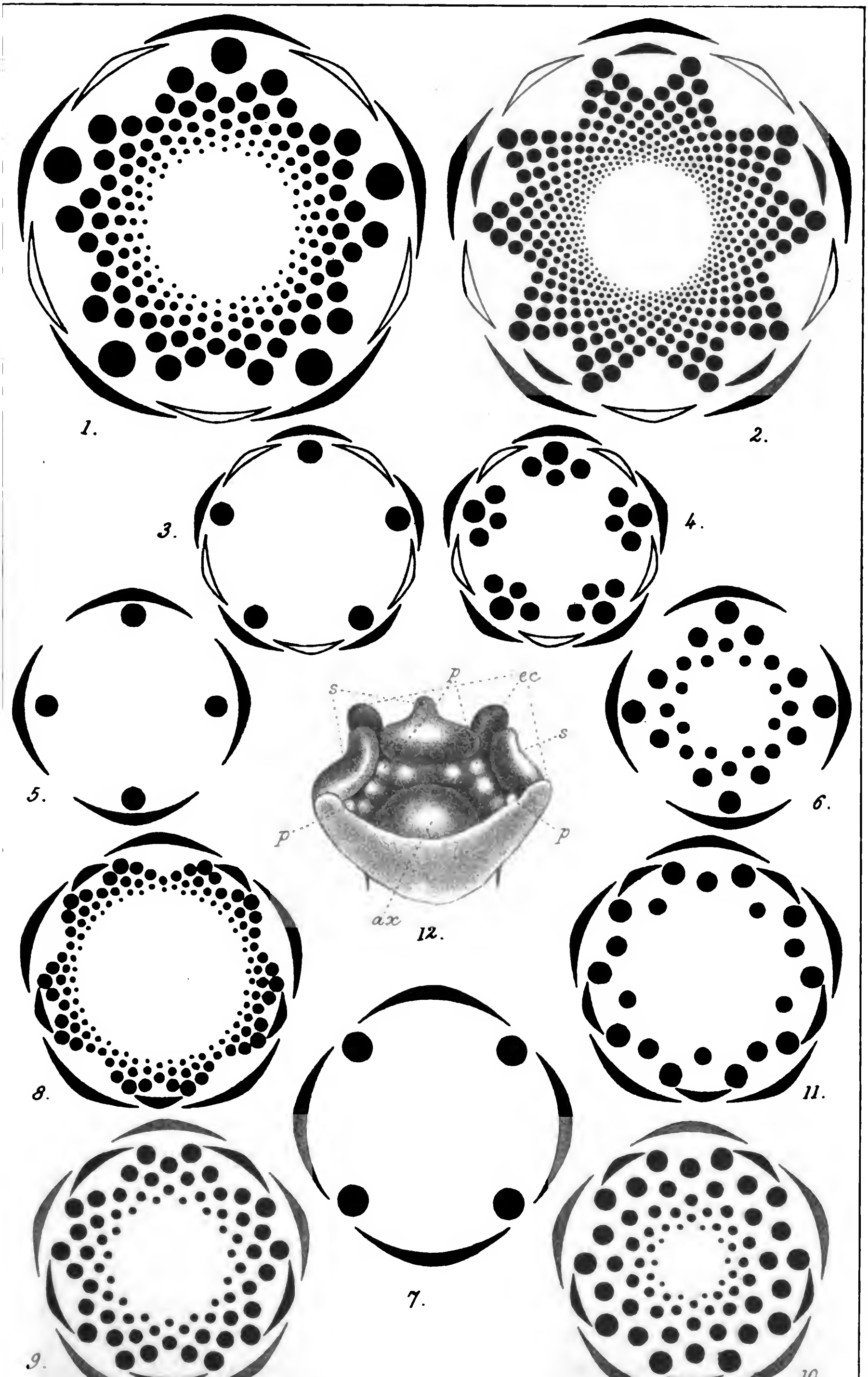

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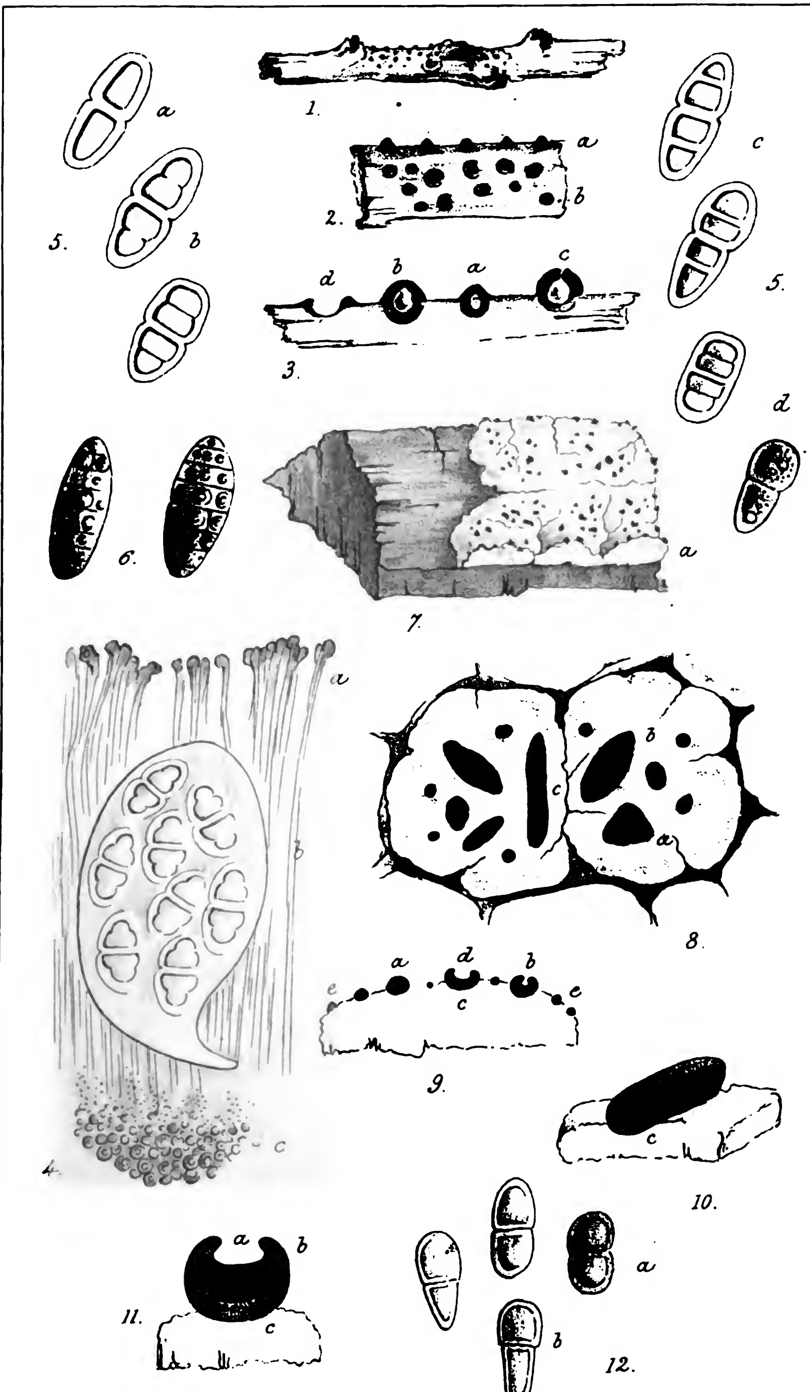

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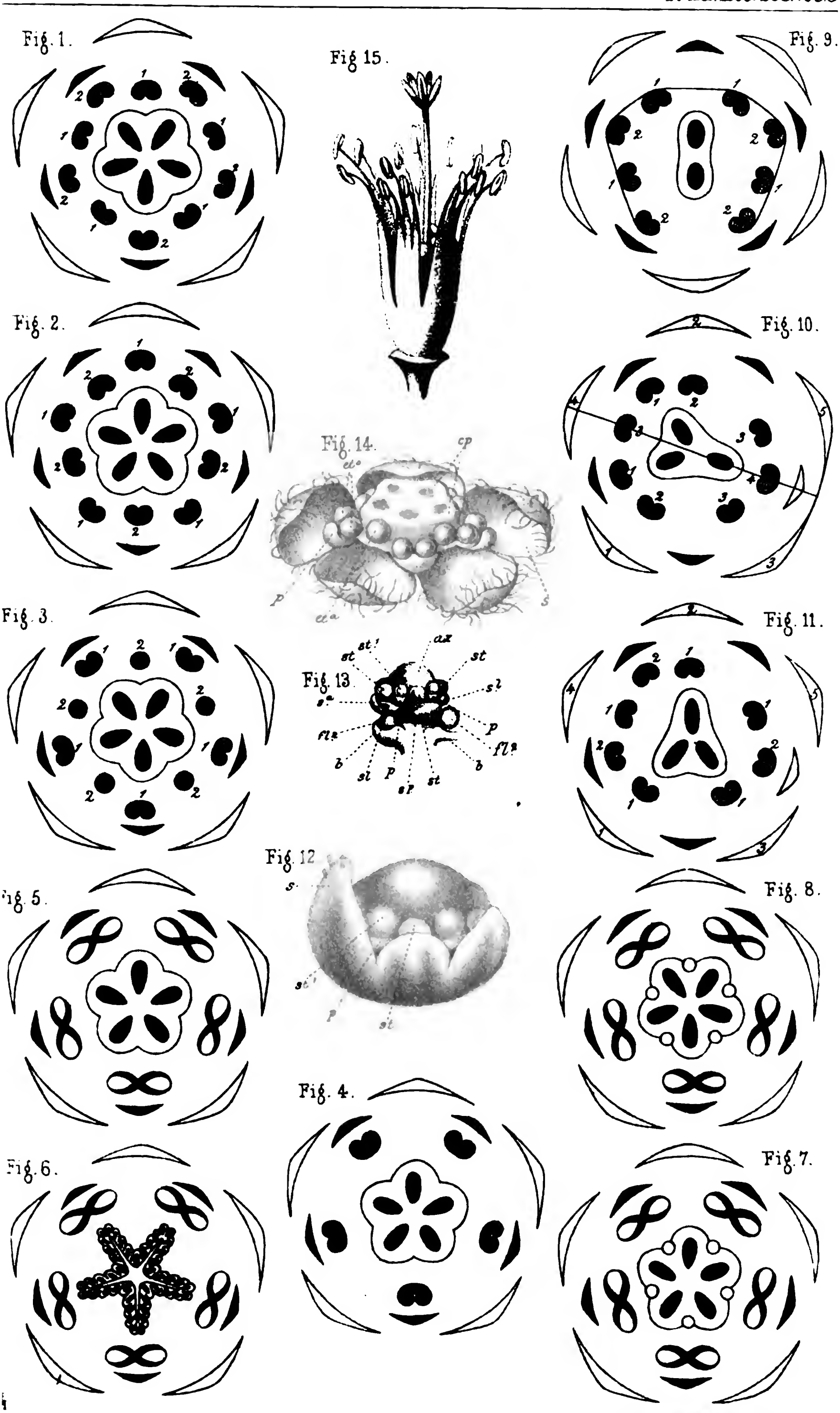

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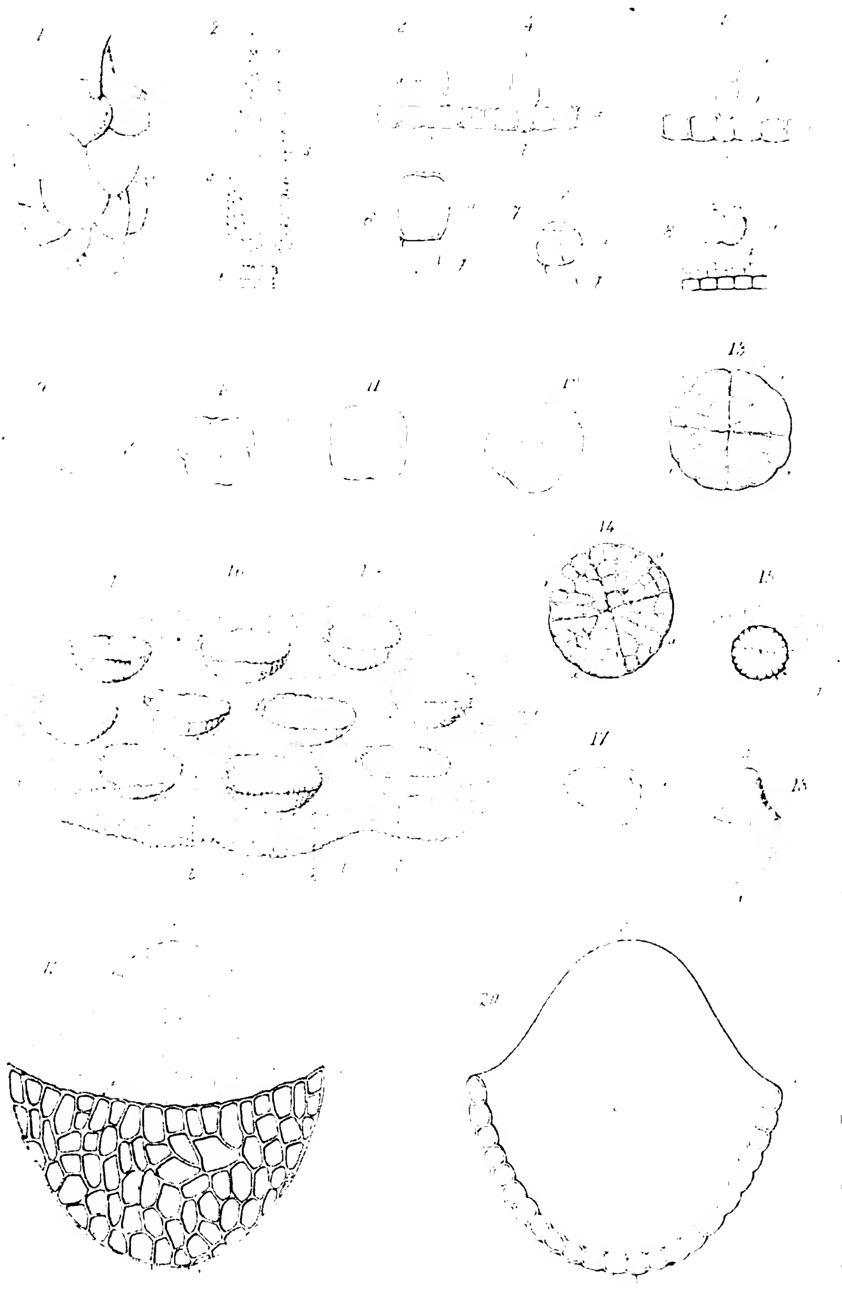

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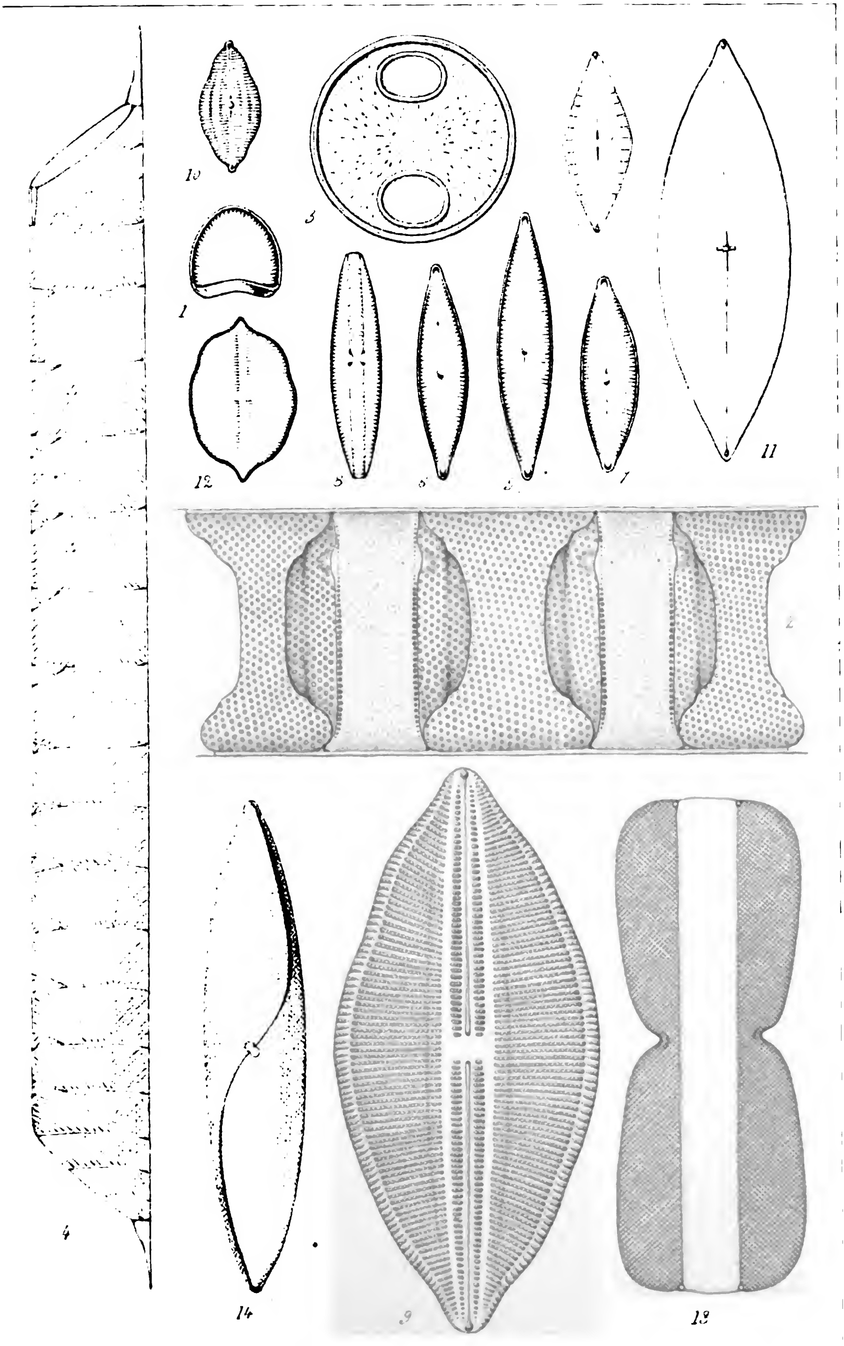
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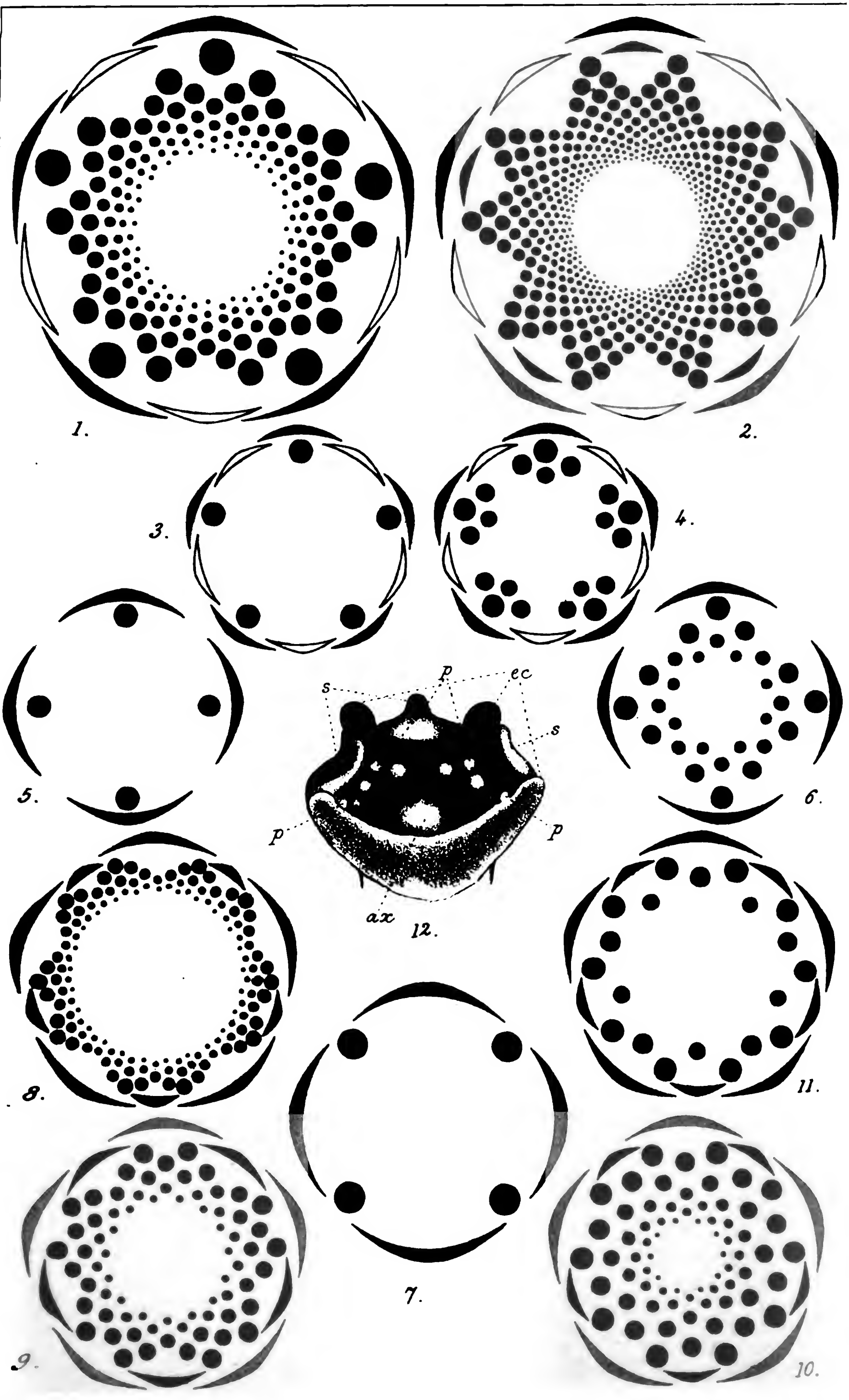

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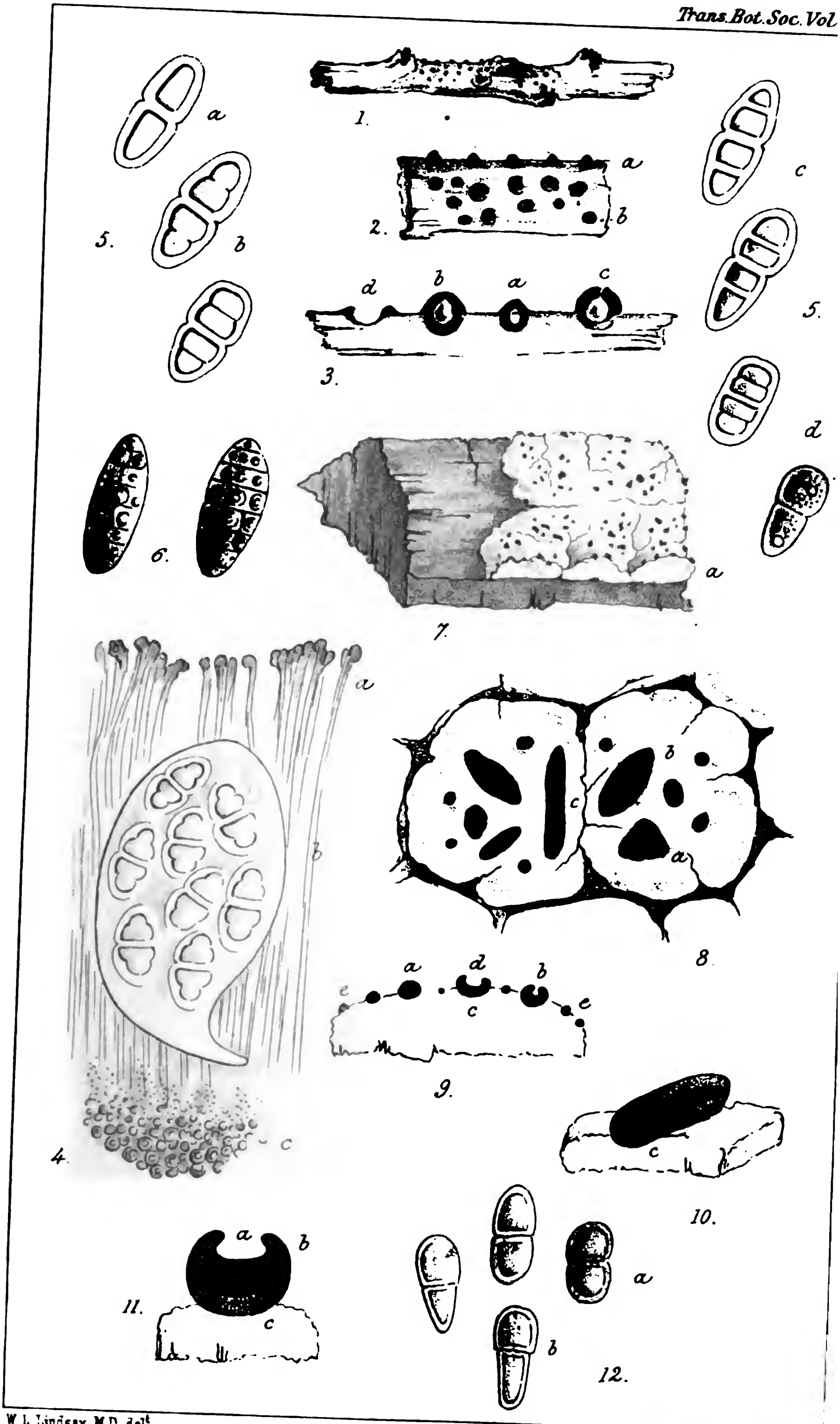

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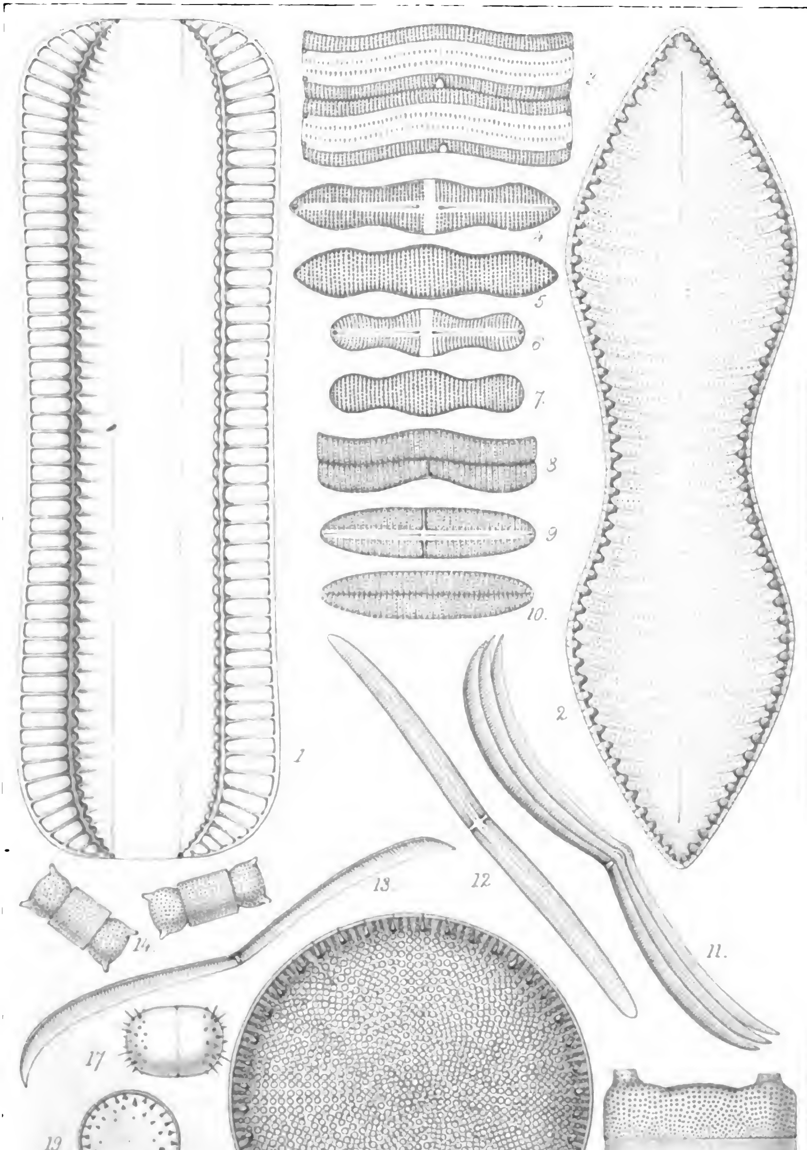

R. K. Greville del. on stone by F. Huth

W. H. McFarlane Lith. Edin.

PLATE VII.

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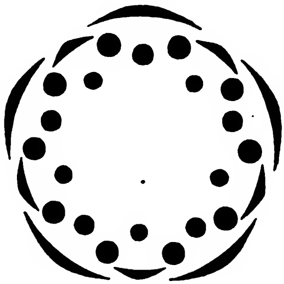
Fig. 1



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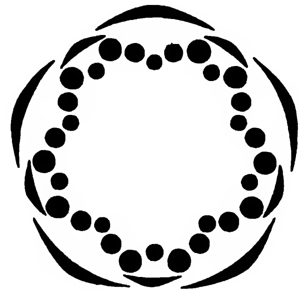

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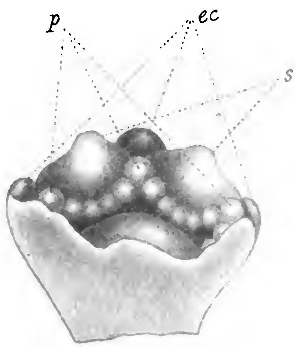

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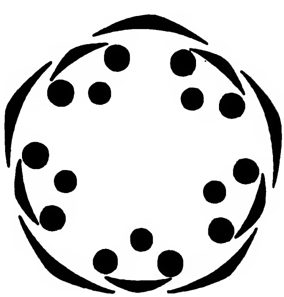

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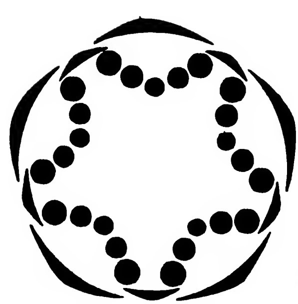

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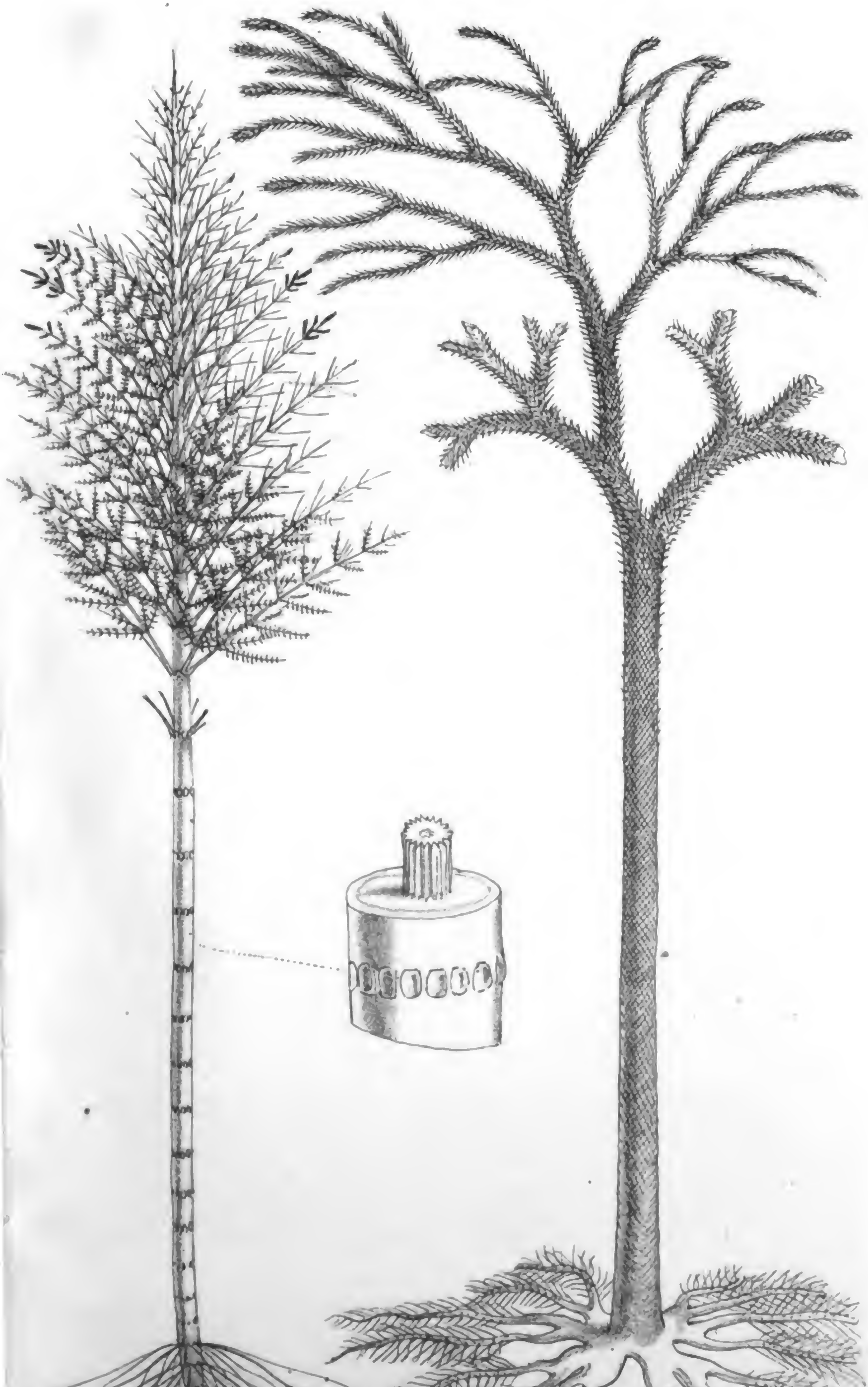

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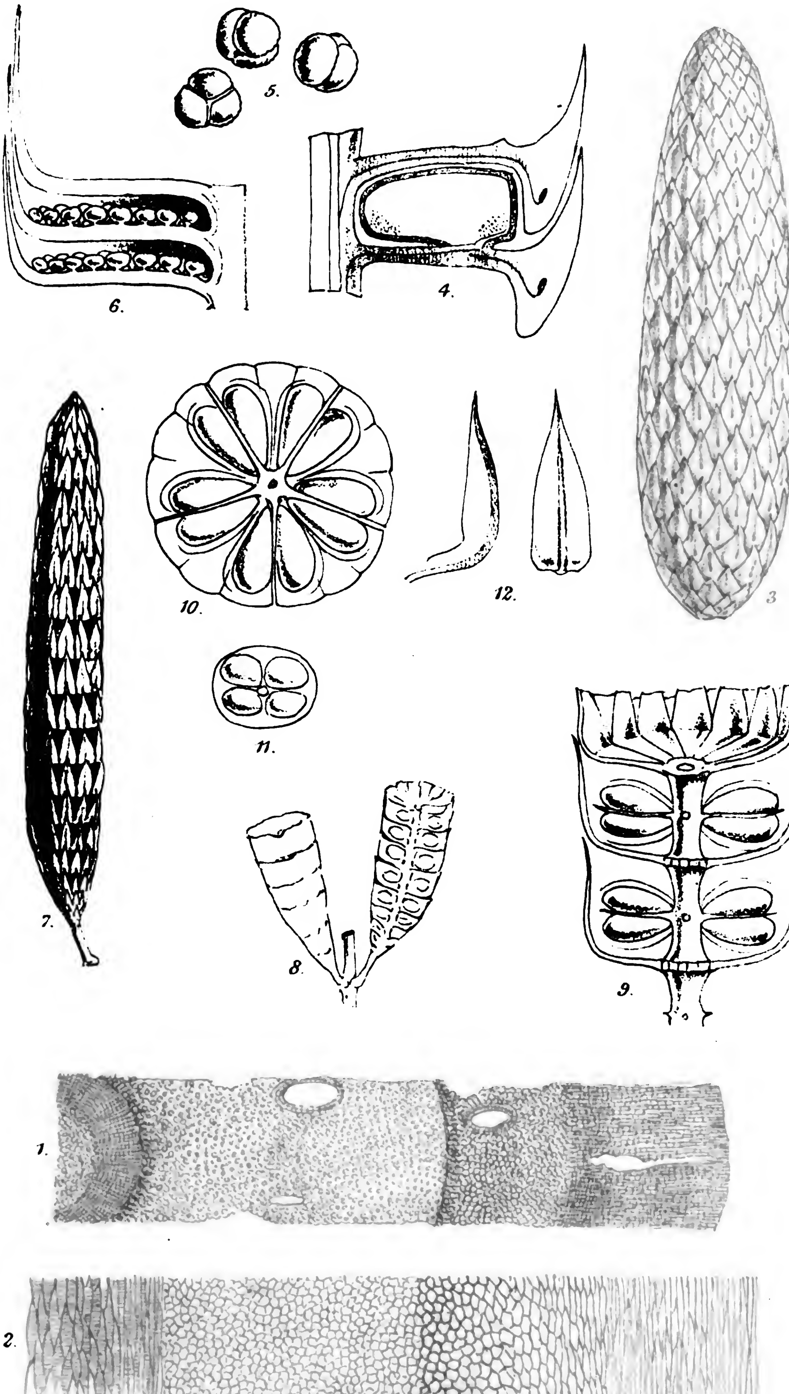

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